Bibliometric Report

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Research performance analysis for the University of Helsinki 2012-2016/17

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Report for the University of Helsinki

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General parameters of the bibliometric study

Parameters:

Database	:	All publications in Web of Science
Classification system	:	Publication-level classification system (about 4,000 fields/areas)
Publication window	:	2012-2016
Citation window	:	Variable length until 2017
Letters	:	Excluded
Counting method	:	Fractional counting at the level of organizations (Full counting: P; fractional counting: P')
Self-citations	:	Excluded
Top indicators	:	Top 10%

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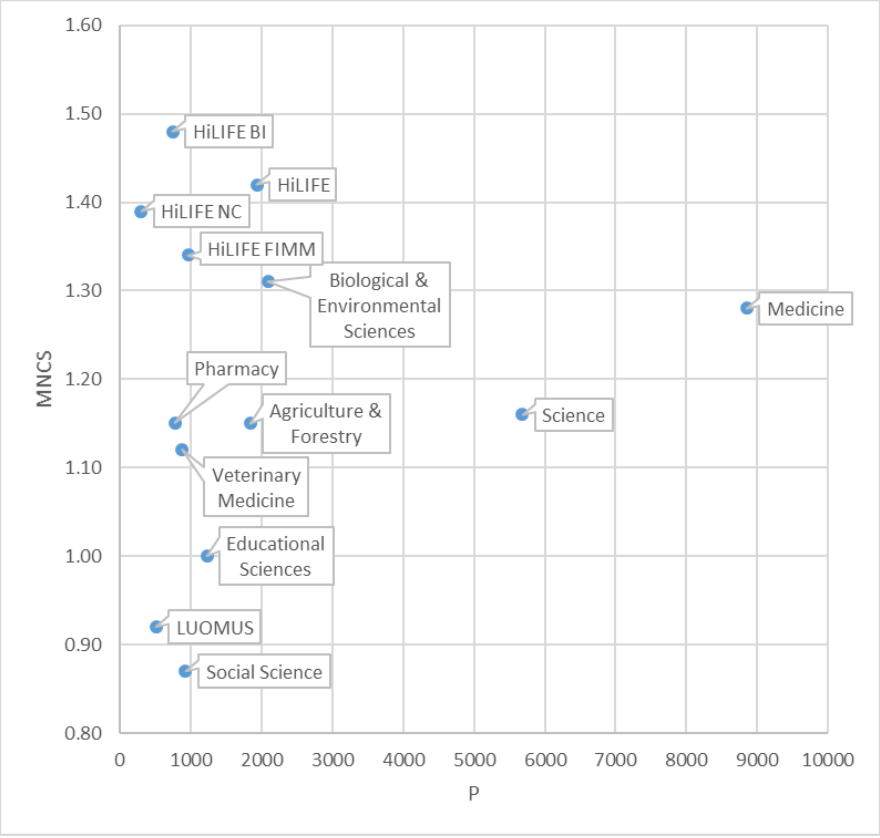
Executive summary

This bibliometric report presents the assessment of the academic quality and impact of research performed at the University of Helsinki (UH) and its faculties using state of the art bibliometric data and methods. We consider this the assessment of their research performance in the period 2012-2016. The impact calculated by citations is used as a proxy for quality of the research at the UH faculties.

UH researchers were involved as co-authors in almost 22,000 publications in the period 2012-2016. Almost 85% of that output is done in collaboration with other organizations, while more than 60% involves international collaboration. The Faculty of Medicine and the Faculty of Science were the faculties with the largest number of publications.

UH researchers manage to get their work published in high impact journals. The impact of the journals in which UH researchers published is 17% above world average.



Output (P) and impact (MNCS) of UH Faculties in the period 2012-2016.

The UH has an impact (MNCS) of almost 20% more than world average in the period of analysis (2012-2016). The proportion of its publications in the top 10% most highly cited ones (PP[top10%]) is 20% higher than expected. The impact by Faculty varies and ranges between 0.87 and 1.48, where 1 is the world average.

We also found large differences among faculties regarding their co-authoring practices. While in one Faculty, the proportion of output co-authored with other organizations is just above 60%, in another, researchers co-author almost 90% of their output with other organizations. Likewise, in one Faculty 2 out of 5 publications involves international collaboration while in another almost 75% involves organizations from other countries. These figures do not reflect the quality or impact of research and mostly illustrate different research practices and publication traditions. However, publications involving international collaboration generally receive higher impact measured in citations.

Indicators and abbreviations

P	Number of publications in international journals of the unit analyzed in the period. A publication must be covered by Web of Science and as such be identified as an article or review.
P'	Number of publications, counted fractionally by the number of co-authoring organizations.
TCS	Number of citations received by P during the entire period, excluding author self-citations. We count citations up to 2017.
MCS	The average number of citations excluding self-citations per paper and in the period to 2017.
MNCS	The mean field-normalized citation score relates the MCS of each publication to the average of the research area to which it belongs. A value above 1 indicates that the unit's mean impact is above world average, whereas a value below 1 indicates the opposite.
MNJS	The mean normalized journal score indicates the average citation impact of the journals that published the papers of the unit analyzed unit. The indicator is calculated on the basis of the same principles as the MNCS. It shows whether the publications originating from the unit analyzed were published in top or sub-top (in terms of citation impact) journals.
PP(top10%)	The proportion of highly cited publications: the proportion of a unit's publications in the top 10th percentile of the citation distribution for papers in the same research area (see below). The world average, or expected value, is 0.10. A unit with a PP (top10%) of 0.12 has 20% more publications in the top 10% than expected or 20% above world average.
IC or IntCov	The internal coverage is a proxy for how well WoS covers the field in which the University of Helsinki (or its faculty) publishes. This proxy is based on the assumption that researchers cite relevant work. The measure is an average per publication of references that are covered by WoS.
PP(collab)	The proportion of a unit's publications that were co-authored with at least one other organization.
PP(intl collab)	The proportion of a unit's publications that were co-authored with at least one organization from another country.
PP(industry)	The proportion of a unit's publications that were co-authored with at least one company in industry.
PP(OA)	The proportion of a unit's publications that were published in (Green or Gold) Open Access
Avg # auth	The average number of authors per publication
Avg # org	The average number of organizations (author affiliations) per publications

1. Introduction

The research at the University of Helsinki is assessed at regular intervals. An assessment is being performed at the time of writing this report (Research Assessment 2018–2019 / University of Helsinki) and previous assessments were executed in 1999, 2005 and 2012. The focus of the current assessment is on the academic quality and impact potential of research performed at University units, as well as their future potential and opportunities to develop operations. The assessment covers all research activities in the University.

The purpose of the assessment is to reveal and confirm the quality and impact of research, assist in recognizing future research prospects, and support renewal. The aim is to produce information that can be used for enhancing quality and supporting strategic decision-making at the University of Helsinki on unit, faculty and University levels.

Bibliometric analysis of research output is an important element in the quantitative assessment of scientific quality of research. In this work, we analyze publication activity and impact at Faculty, Institute and University level. The role of this analysis with respect to the Research Assessment is twofold. On the one hand, the analysis provides up-to-date understanding about the publication activity within the University. On the other hand, for development planning, qualitative and quantitative assessments performed for the Research Assessment at Unit level can be placed in broader context with the results from the larger units of this analysis.

The results presented in this study are presented by faculty. In Annex D, we present the results of the analysis of UH data, aggregated by WoS journal categories.

2. Data and method

In this section, we briefly describe the approach to data collection and the methods used. Further relevant details about the methods and approach are given in the Annexes.

The publication data for this study were collected by the University of Helsinki. At the level of each unit analyzed unit, Web of Science (WoS) publication identifiers (WoSIDs) were provided. CWTS checked the data provided and linked them to its database dedicated to bibliometrics research evaluation studies.

The indicators discussed in this section are used in different chapters (3 and 4) of the report.

Indicators

Output indicators

The simplest output measure regards the number of publications (*P*) in which a unit was involved during the period analyzed. In addition, we provide the indicator *P'* which assesses a unit's contribution to the output P. Each publication is divided by the number of organizations co-authoring. P' is the sum of these fractions of publications in which a unit is involved.

This study is based on publications covered by WoS. Hence, we do not necessarily cover the entire output of a unit. We use the internal coverage (*IntCov* or *IC*) indicator to assess the representativeness of the WoS output. The extent to which WoS covers the research in which units are active varies greatly. And although there is no absolute figure on this, we consider the internal coverage to be a good proxy. If IC is higher than 0.5 we consider the majority of the output of a unit represented in the WoS sample. The internal coverage indicator measures the average proportion of references being covered by WoS. If a publication has 10 references and 6 of them are in WoS, the internal coverage of this publication is 0.6. Based on the assumption that researchers primarily cite relevant material, we believe that the average proportion of references covered by WoS is a good proxy for the WoS coverage of the research in which a unit publishes.

Other indicators that characterize the output are the proportion of the output involving collaboration (*PP[collab]*, where authors from more than one organization were involved) and international collaboration (*PP[intl collab]*, where authors from more than one country were involved). We also introduce the proportion of publications

published in (Green or Gold) Open Access: *PP[OA]* (van Leeuwen, Meijer, Yegros-Yegros, & Costas, 2018).

In Chapter 3, we use additional output indicators to illustrate the practices of research fields in which units publish. They characterize sets of publications by the average number of co-authors and co-authoring organizations (*[Avg # Auth]* and *[Avg # Org]*).

Impact indicators

The impact of a unit's output is measured by citations. We provide statistics on the total number of citations (*TCS*) received, the average per publication (*MCS*) and the normalized average (Mean Normalized Citation Score, *MNCS*). In addition, we provide the proportion of publications in the top 10% most cited publications (within their research area and in the same year, *PP[top10%]*). This indicator correlates with the MNCS but is not sensitive to outliers. The MNCS can sometimes be biased by one paper being cited very many times. This may particularly occur in cases where there are smaller numbers of papers. It cannot be ignored, of course, but readers should be made aware of this. The PP(top10%) is not influenced by this one paper, as it is 'just' one of the top 10%. If the MNCS is much higher than the 'matching' PP(top10%), this is due to such a skewed distribution.

As mentioned above, the citation impact is normalized by research area and year. The research area to which a publication belongs is defined by a publication-level classification (for details, see Annex B: Publication-based classification). In this classification each publication is in a cluster (class) of similar publications. The similarity is defined by their citation environment (cited and citing publications). In a journal classification all publications from one journal are in the same class. Similar journals are in the same class and journals may belong to more than one class. These classes are also referred to as journal categories.

The publication-based classification is much more fine-grained than any existing journal classification (Ruiz-Castillo & Waltman, 2015), because it takes account of diverse citation practices among research areas and provides a proper context for publications in multidisciplinary and general journals. This classification is used for normalization of impact. The WoS journal classification is used in the research profiles to characterize the output of a unit (see section on Unit profiles).

Finally, we also use an indicator measuring the impact of journals, the Mean Normalized Journal Score (*MNJS*). This indicator assesses the journals (aggregated) used by the unit in terms of citation-based impact, using the same normalization as

we use for measuring the unit's impact (MNCS). As such, the MNJS does not measure the (average) impact of a unit's publications, but rather the impact of the *journals* in which a unit managed to publish. We will discuss this in more detail in Chapter 3.

Counting method

As most publications are produced in collaboration with other organizations, we should take this aspect into account when measuring impact. A recent study showed that on average the more co-authoring organizations are involved, the higher the impact (Waltman & van Eck, 2015). Co-authored papers benefits more from full counting than other papers. To correct for this effect, a method of fractional counting of publications to measure impact has been developed. We use this method for impact scores but use full counting of publications for output scores (P). In the research profiles and detailed statistics, we also provide *P'*, representing the quantity as measured by fractional counting. P' for a publication is a fraction of 1 that depends on the number of organizations involved in the publication. If four different organizations are involved, this publication is counted as 0.25. For impact measurement, we calculate all citations according to the set criteria, but the contribution of this publication's impact is divided by four (i.e., multiplied by 0.25).

Unit profiles

Output

For each unit, we provide a research profile and a collaboration profile, which characterize a unit's output and impact in more detail. These profiles comprise a distribution (both output and impact) across output types. In the case of a research profile, we distribute the output across the 250 journal categories of WoS (a.k.a., the WoS journal classification). Journal classes provide a coarse structure of all sciences. By distribution a unit's output across these classes we provide a broad overview of their activities and focus.

For collaboration profiles, we classify publications by the co-authoring organizations. The different types of collaboration are: international collaboration for publications co-authored by organizations from at least two countries and national collaboration for publications with at least two different organization co-author from the same country.

Impact

In the profiles, the impact of individual publications is measured in the same way as we do for the entire unit (MNCS and MNJS normalized by the publication-based classification). This means that the impact is measured fractionally and aggregated by category. In the profile we rank categories on the basis of full counting. In this way we depict a unit's focus by the number of publications in which it is involved, while the impact is measured by the proportion to which it contributes, hence consistent with the overall impact measurement. In each profile we also provide P' measuring distribution of impact over categories.

For the research profiles, we fractionalize for impact at the organization level, but the WoS journal categories are ranked on the basis of full counting. In the case of publications weighted by journal assignment, if a publication is in a journal that belongs to two categories, it is assigned to each category as 0.5. In addition, we also provide the fractionalized numbers (P') to show the effect of collaboration.

In the research profiles, we provide P, P', MNCS and MNJS, while for the collaboration profile we provide P, MNCS and MNJS but not P'. In view of the purpose of this profile, this indicator is confusing and difficult to interpret.

3. Output analyses

In this section, we discuss the output of the University of Helsinki (UH). To characterize the output at the level of the units analyzed, we calculated both the number of articles and reviews and the fractionalized number (P'). This information provides some background material to account for measuring impact by means of fractional counting. In Table 3-1, we also provide statistics on the average number of co-authors as well as the average number of co-authoring organizations per unit. These figures offer insight into the large differences that exist between faculties and fields. Finally, we give an estimation of the extent to which WoS covers each unit's research. This estimation involves a proxy for WoS coverage, measured by the internal coverage (IC) indicator.

Table 3-1 Output characterization by UH units

Unit name	Avg # auth	Avg # org	IC	P	P'	PP (OA)
University of Helsinki	61	11	0.80	21,912	8,622	0.39
Faculty of Agriculture and Forestry	7	4	0.79	1,839	844	0.31
Faculty of Biological and Environmental Sciences	9	5	0.85	2,087	944	0.41
Faculty of Educational Sciences	11	6	0.64	1,229	557	0.28
Faculty of Medicine	14	8	0.91	8,851	2,852	0.37
Faculty of Pharmacy	8	3	0.92	773	335	0.24
Faculty of Science	216	26	0.83	5,681	2,027	0.54
Faculty of Social Sciences	5	3	0.49	923	550	0.23
Faculty of Veterinary Medicine	7	3	0.90	881	425	0.43
HiLIFE (BI, FIMM, NC)	19	9	0.94	1,937	678	0.59
• Institute of Biotechnology (BI)	8	3	0.94	749	363	0.54
• Institute for Molecular Medicine Finland (FIMM)	30	16	0.93	963	201	0.65
• Neuroscience Center (NC)	11	5	0.96	296	136	0.50
Finnish Museum of Natural History LUOMUS	6	4	0.65	512	220	0.28

When we look at the faculties and institutes within UH, we see large differences in terms of output. The Faculty of Medicine contributed to the most publications (8,851), while the Faculty of Pharmacy contributed to 773. If we take these two as an example,

we also see large differences regarding co-authorships. A publication where researchers of the Faculty of Medicine are involved has on average 14 co-authors, while the average for publications involving the Faculty of Pharmacy is 8. And the difference in the number of co-authoring organizations of a publication is even greater: 8 for publications involving the Faculty of Medicine and 3 for the Faculty of Pharmacy. Organizations publishing with more co-authors, tend to have more publications.

It is also worth mentioning that the Faculty of Science has huge numbers of authors and co-authoring organizations per publication. This is mainly due to publications with thousands of authors in High Energy Physics. Obviously, this is something we should not ignore when we measure the impact of a unit. Measuring impact by taking account of the number of co-authoring organizations (i.e., fractionalization) deals with these differences.

An additional characterization included in the table is the proportion of output published in (Green or Gold) Open Access (PP[OA]). The approach to determine Green or Gold OA is described in (van Leeuwen et al., 2018). We observed large differences among faculties and institutes. This is not an indicator of quality or impact but is a good illustration of the visibility for the rest of the world. Particularly worth mentioning are the Faculty of Science and HiLIFE, where more than 50% of their output is published OA. Surprisingly, in the Faculty of Social Sciences, the Faculty of Educational Sciences and LUOMUS, the output published OA is below 30%. The fact that the OA output in the Faculty of Pharmacy is below 30% may be due to the important role of the pharmaceutical industry in this field.

Finally, we found large differences in the extent to which WoS covers a unit's output, i.e., the extent to which the WoS sample is representative of the whole unit (internal coverage, IC). In almost all cases the coverage is high (>0.7). In two units, the coverage is around 0.65, but in one unit (Faculty of Social Sciences) the coverage is estimated at just below 0.5. This means that in 13 out of 14 units, we will be looking at a large proportion of the output, while for one unit we will be looking at approximately half of its output.

Table 3-2 lists the most frequently used journals (P UH), together with some bibliometric statistics. For each journal we calculated the estimated WoS coverage in the field to which it belongs, the number of articles and reviews overall in the period 2012-2016 and the two impact indicators (MNCS and PP[top10%]). The list is dominated by multidisciplinary journals (e.g., PLOS ONE and Scientific Reports), and natural science journals. The top 8 journals each contain more than 150 UH publications, while the other journals contain less than 100. The impact of the top 8

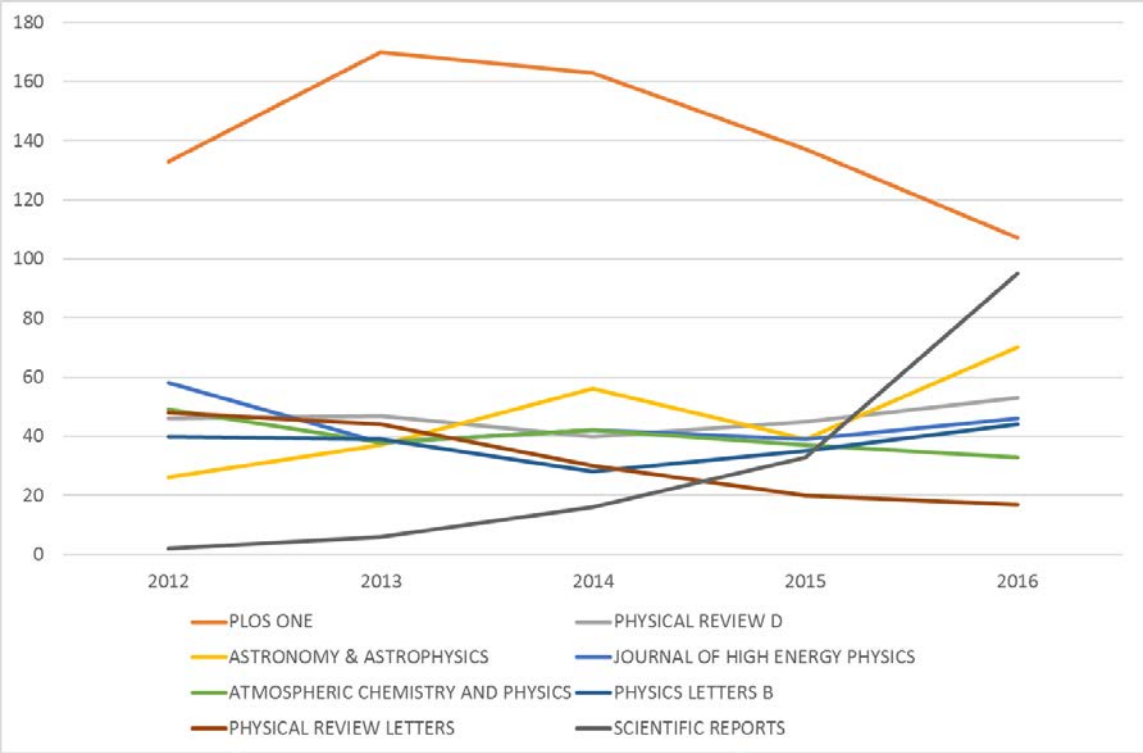
is almost always well above world average. Physical Review Letters, with nearly fifteen thousand publications, has an MNCS of 2.65 and PP(top10%) of 0.36. Only PLOS ONE has an impact slightly below world average/expected. Of the journals with less than 100 publications from UH, Nature and Nature genetics are worth mentioning with an extremely high impact over seven- and nine times world average. In both cases around 90% (!) of their articles and reviews belong to the top 10% most highly cited.

Table 3-2 Top 25 journals used most often by UH (2012-2016)

Journal	P UH	WoS coverage journal	P journal	MNCS journal	PP (top10%) journal
PLOS ONE	710	0.88	135,196	0.94	0.08
PHYSICAL REVIEW D	231	0.91	16,915	1.12	0.12
ASTRONOMY & ASTROPHYSICS	228	0.89	9,046	1.10	0.09
JOURNAL OF HIGH ENERGY PHYSICS	223	0.88	10,127	1.21	0.13
ATMOSPHERIC CHEMISTRY AND PHYSICS	199	0.90	3,872	1.49	0.19
PHYSICS LETTERS B	186	0.84	4,193	1.22	0.13
PHYSICAL REVIEW LETTERS	159	0.93	14,993	2.62	0.36
SCIENTIFIC REPORTS	152	0.92	38,462	1.21	0.13
PHYSICAL REVIEW C	95	0.92	5,430	1.18	0.12
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA	95	0.93	17,755	2.83	0.43
EUROPEAN PHYSICAL JOURNAL C	92	0.84	2,645	0.97	0.09
STROKE	90	0.93	2,830	1.82	0.25
BOREAL ENVIRONMENT RESEARCH	89	0.79	228	0.41	0.01
NATURE COMMUNICATIONS	81	0.95	11,829	3.03	0.45
ANNALS OF MEDICINE	80	0.93	388	0.92	0.11
NATURE GENETICS	78	0.97	1,020	7.49	0.88
JOURNAL OF PHYSICAL CHEMISTRY A	75	0.92	6,458	0.90	0.08
JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS	75	0.92	3,155	1.02	0.11
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY	67	0.91	14,507	1.06	0.11
PLOS GENETICS	64	0.96	3,732	1.66	0.22
ASTROPHYSICAL JOURNAL	62	0.91	14,761	1.24	0.13
INTERNATIONAL JOURNAL OF CANCER	60	0.94	3,188	1.55	0.17
NATURE	58	0.93	4,366	9.76	0.91
PHYSICAL CHEMISTRY CHEMICAL PHYSICS	58	0.94	13,882	1.01	0.09
BIOGEOSCIENCES	58	0.86	2,231	1.22	0.13

For the top 8 journals we also investigated the trends over time (2012-2016). In Figure 3-1, we clearly discern a pattern in which the prominent position of PLOS ONE is being taken over by another open access journal, Scientific Reports. Most of the other top 8 journals contain a stable number of UH publications throughout, although Physical Review Letters shows a decreasing number of UH publications.

Figure 3-1 Number of UH publications per year in the most popular UH journals



4. Results by unit analyzed

In this section we discuss the units of the University of Helsinki that we analyzed with our standardized bibliometric performance assessment method. These units include the entire University as well as a selection of faculties and institutes. This selection contains only units with a reasonable proportion (i.e., at least 45%) of output covered by Web of Science: we want the research output of these units to be properly represented in the analyses. Table 3-1 in the previous chapter, presents the internal coverage by unit.

University of Helsinki

In this first section, we describe the results for the University of Helsinki (UH) as a whole. These results provide an overview of its performance from the bibliometric perspective but lack the details to link the results to the organizational structure (which will be covered in the succeeding sections). Although some detail is provided by the research profile, it should be noted that the research fields in this analysis are defined by sets of journals (WoS journal categories) and not by any organization structure of UH. The publication set used for this part of the study covers the fields in which the selected set of units are active.

Table 4-1 Overall and trend performance 2012-2016 of University of Helsinki

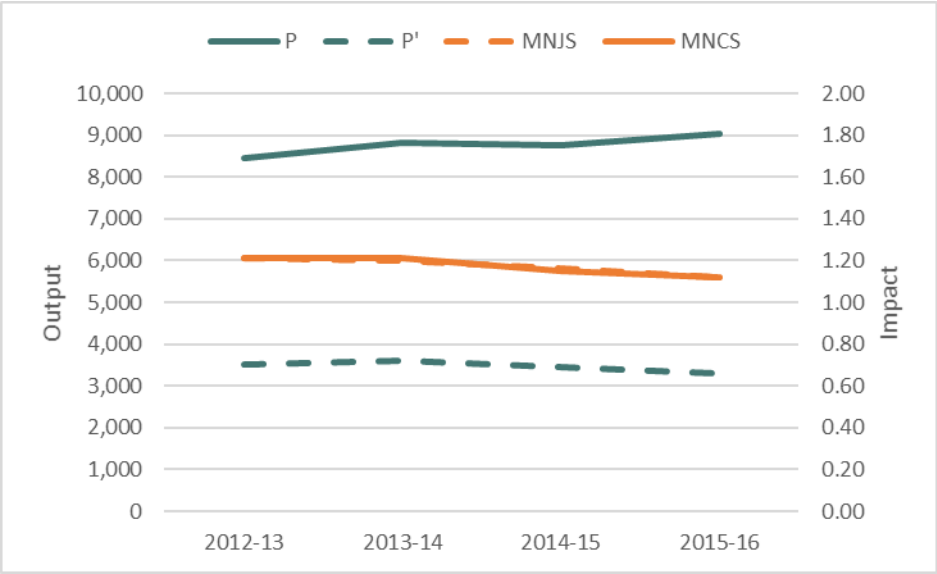
Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	21,910		8,437	8,814	8,774	9,025
P'	8,619.5		3,511.1	3,611.3	3,445.5	3,304.1
WoS coverage *	0.80		0.81	0.79	0.79	0.79
MNJS	1.17		1.21	1.20	1.16	1.12
TCS	68,388		42,429	33,160	22,046	11,833
MCS	7.93		12.08	9.18	6.40	3.58
MNCS	1.17		1.21	1.21	1.15	1.12
PP(top10%)	0.12		0.13	0.12	0.12	0.11
P(top10%)	1,034		456	433	413	363

* WoS coverage is calculated by the internal coverage indicator (IntCov or IC)

The overall results show that UH co-authors an increasing number of publications from year to year, up to more than 9,000 in 2015/16. If we count the output fractionally, i.e., if we consider (and normalize for) the number of co-authoring organizations, the output remains at the same level throughout and even drops somewhat. This means that UH researchers are involved in more publications primarily because co-authoring teams have become larger, i.e., there are more co-authoring organizations involved. Research may have become more interdisciplinary or more complex, requiring more partners.

The impact of UH as measured by MNCS decreases somewhat from 21% to 12% above world average. The PP(top10%) shows a similar trend from 0.13 to 0.11. Both indicators reveal that the impact is still well above world average.

Figure 4-1 Performance trend (output and impact) of University of Helsinki



The research profile of UH (Figure 4-2) shows the top 30 of WoS journal categories in which UH has published. The complete list of categories is available in Annex C.

The profile shows that much of its output is published in Multidisciplinary journals. As such, this research may be published in any field of science. As we saw in the previous chapter, PLOS ONE is by far the most popular UH journal to publish research results. We also saw that another Open Access journal, Scientific Reports, is rapidly becoming the most popular journal. The impact of the UH research in multidisciplinary journals is high: almost 60% above world average. We also found that in the great majority of the most relevant fields (i.e., the 15 categories with the highest output of the research profile) the impact was quite high: between 1.10 and 1.6 (MNCS). The impact of research published in *Public, Environmental & Occupational Health* journals and research published in *Meteorology & Atmospheric Sciences* journals is just below world average. The impact of journals (MNJS) used by UH in the field of *Public, Environmental & Occupational Health* is also below world average. In the case of *Meteorology & Atmospheric Sciences*, the impact of UH journals is above world average. It should be noted here that the impact of the journals (MNJS) is measured by using a much more fine-grained normalization than the WoS journal categories (See Annex B: Publication-

based classification). Journals in very specialized fields with less attention are compared to journals with similar focus but also to subsections of multidisciplinary and general journals with that focus. This may have two (counterbalancing) effects that are visible here:

1. Journals in specialized fields may suffer from the attention of broader journals;
2. Multidisciplinary journals may benefit from the lower visibility of specialized journals.

Figure 4-2 Research profile (output and impact) of University of Helsinki

WoS field	P	P'	MNCS	MNJS
MULTIDISCIPL SC	1,193	386	1.57	1.56
ASTRON&ASTROPH	693	134	1.05	1.15
PHYSICS,PART&FIE	572	78	1.11	1.14
GENETICS&HEREDIT	551	132	1.57	1.57
ONCOLOGY	535	147	1.37	1.29
ENDOCRIN&METABOL	490	115	1.38	1.54
PUBL,ENV&OCC HLT	468	155	0.94	0.98
ENVIRONMENTAL SC	464	198	1.00	1.10
ECOLOGY	460	192	1.34	1.36
NEUROSCIENCES	448	175	1.13	1.28
METEOR&ATMOS SC	445	137	0.97	1.17
CLIN NEUROLOGY	430	148	1.43	1.29
BIOCHEM&MOL BIOL	420	166	1.45	1.33
PHARMACOL&PHARMA	366	164	1.23	1.24
PLANT SCIENCES	337	147	1.25	1.22
SURGERY	330	169	1.21	1.20
MEDICINE,GEN&INT	328	85	3.27	3.11
MICROBIOLOGY	320	141	1.19	1.22
PSYCHIATRY	287	78	1.17	1.11
CELL BIOLOGY	279	111	1.59	1.47
FORESTRY	270	126	1.05	1.00
PEDIATRICS	259	99	0.95	0.94
MATHEMATICS	246	149	1.42	1.33
CARD&CARDIOV SYS	246	68	1.90	1.62
PHYSICS,NUCLEAR	236	51	0.89	0.81
PHYSICS,MULTIDIS	235	41	2.97	2.82
IMMUNOLOGY	228	72	1.14	1.19
EDUCAT&EDUC RES	227	162	0.84	0.87
PSYCHOL,MULTID	222	91	1.06	1.12
GEOSC,MULTIDISC	210	73	0.99	1.06

In all other cases of the most prominent fields shown in the profile, the UH journals have an impact well above world average.

Overall, we can say that UH has a preference for publishing in multidisciplinary (OA) journals. Both the impact of the journals used and the impact of UH publications are well above world average. There is a slight decrease in both MNCS and MNJS over the studied period (2012-2016).

UH publishes its research primarily in collaboration with other organizations (Figure 4-3). Only 16% of its publication output is produced without any external co-authoring partner. A large majority (over 60%) of its output involves international collaboration. The impact of this international collaborative work, as well as the impact of the journals in which it is published, is high (33-40% above world average). The impact of the other types of output is much lower, i.e., less than 10% above world average).

Figure 4-3 Collaboration profile (output and impact) of University of Helsinki

Collaboration	P	MNCS	MNJS
Intl collab	13,330	1.40	1.33
Nat collab	5,020	1.02	1.06
Single inst	3,562	1.05	1.09

Table 4-2 gives a breakdown of bibliometrics scores over the units considered in this report. The details for each UH component (faculty or institute) will be discussed in the next sections.

Table 4-2 General bibliometric scores of studied units (2012-2016)

Unit	P	MNJS	MNCS	PP(top10%)	PP (industry)	PP (collab)	PP (intl collab)
University of Helsinki	21,912	1.17	1.17	0.12	0.07	0.84	0.61
Faculty of Medicine	8,851	1.24	1.28	0.13	0.09	0.89	0.58
Faculty of Science	5,681	1.17	1.16	0.12	0.06	0.87	0.74
Faculty of Pharmacy	773	1.18	1.15	0.12	0.12	0.86	0.58
Faculty of Biological and Environmental Sciences	2,087	1.32	1.31	0.15	0.03	0.81	0.61
Faculty of Educational Sciences	1,229	1.04	1.00	0.10	0.04	0.78	0.46
Faculty of Social Sciences	923	0.99	0.87	0.08	0.01	0.62	0.40
Faculty of Agriculture and Forestry	1,839	1.18	1.15	0.11	0.05	0.82	0.55
Faculty of Veterinary Medicine	881	1.11	1.12	0.10	0.09	0.77	0.57
HiLIFE (BI, FIMM, NC)	1,937	1.39	1.42	0.17	0.11	0.86	0.69
• Institute of Biotechnology (BI)	749	1.37	1.48	0.17	0.04	0.77	0.61
• Institute for Molecular Medicine Finland (FIMM)	963	1.37	1.34	0.15	0.18	0.96	0.79
• Neuroscience Center (NC)	296	1.48	1.39	0.17	0.05	0.78	0.63
Finnish Museum of Natural History LUOMUS	512	1.01	0.92	0.07	0.01	0.85	0.66

Faculty of Agriculture and Forestry

The Faculty of Agriculture and Forestry is an expert in the responsible use of renewable natural resources both in Finland and worldwide. We focus on the agricultural and forest sciences, food and nutrition, microbiology, as well as on economics and management.

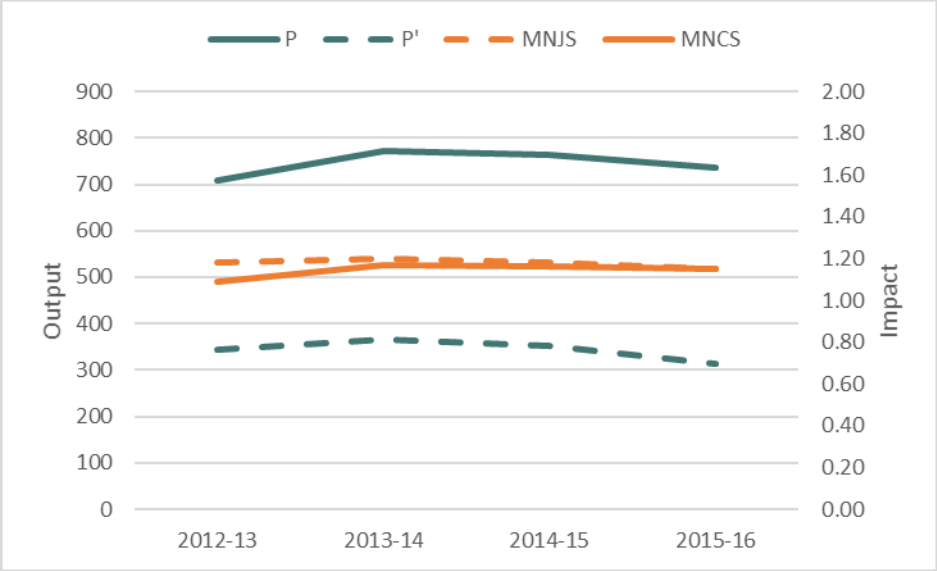
Source: UH website

Table 4-3 Overall and trend performance 2012-2016 of the Faculty of Agriculture and Forestry

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	1,839		709	771	763	735
P'	843.7		344.9	366.9	351.4	313
WoS coverage	0.79		0.79	0.79	0.80	0.80
MNJS	1.18		1.18	1.20	1.18	1.15
TCS	5,961		3,532	3,037	2,096	1,015
MCS	7.07		10.24	8.28	5.97	3.24
MNCS	1.15		1.09	1.17	1.16	1.15
PP(top10%)	0.11		0.11	0.12	0.12	0.11
P(top10%)	93		38	44	42	34

The research at the Faculty of Agriculture and Forestry in the period 2012-2016 resulted in 1,839 articles and reviews. We estimate that around 80% is covered by WoS, which means that the sample is representative to measure output and impact.

Figure 4-4 Performance trend (output and impact) of the Faculty of Agriculture and Forestry



The output of this Faculty is stable throughout the period 2012-2016 at around 360 publications per year. The impact is also stable at almost 20% above world average (for both MNCS and PP[top10%]). The impact of the journals in which the research is published is at the same level throughout.

Figure 4-5 Research profile (output and impact) of the Faculty of Agriculture and Forestry

WoS field	P	P'	MNCS	MNJS
FORESTRY	230	109	1.10	1.01
ENVIRONMENTAL SC	140	66	0.97	1.15
PLANT SCIENCES	131	60	1.27	1.39
FOOD SC&TECHNOL	111	60	1.03	1.22
ECOLOGY	90	39	1.12	1.22
MULTIDISCIPL SC	86	37	1.84	1.89
MICROBIOLOGY	85	38	1.11	1.14
BIOTECH&APPL MIC	62	30	1.19	1.09
NUTRITION&DIET	54	20	1.05	1.18
REMOTE SENSING	42	16	1.68	1.47
SOIL SCIENCE	41	20	1.34	0.99
AGRONOMY	35	17	0.81	0.95
METEOR&ATMOS SC	35	11	1.17	1.36
BIOCHEM&MOL BIOL	34	13	1.09	1.01
AGRIC,DAIRY&ANIM	34	18	1.01	1.14

The research profile of this Faculty matches the mission as presented in the description of the Faculty on the UH website. In the WoS fields of Forestry, Plant Sciences, Food S&T and Ecology, the Faculty contributed to 90 publications or more with an impact above world average. In Environmental Sciences is the impact just below world average. In the field of Microbiology the Faculty contributed to 85 publications, with an impact well above world average. The fields of Economics and Management are not in the top 15 most prominent fields. Research in this area may have been published in one of the top 15 fields, but it is not visible as such.

Figure 4-6 Collaboration profile (output and impact) of the Faculty of Agriculture and Forestry

Collaboration	P	MNCS	MNJS
Intl collab	1,004	1.33	1.26
Nat collab	505	0.98	1.11
Single inst	330	1.08	1.16

The majority of output to which the Faculty contributed involved international collaboration (55%). This type of output has the highest impact and is published in high-impact journals.

Faculty of Biological and Environmental Sciences

The Faculty of Biological and Environmental Sciences with its neighbouring units forms the largest and most prominent scientific and educational unit for life sciences in Finland.

Source: UH website

Table 4-4 Overall and trend performance 2012-2016 of the Faculty of Biological and Environmental Sciences

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	2,087		822	860	828	849
P'	943.5		401.9	396.8	364	356.5
WoS coverage	0.85		0.85	0.85	0.84	0.84
MNJS	1.32		1.34	1.42	1.32	1.29
TCS	9,263		5,902	4,792	2,908	1,379
MCS	9.82		14.69	12.08	7.99	3.87
MNCS	1.31		1.38	1.41	1.28	1.22
PP(top10%)	0.15		0.16	0.17	0.14	0.13
P(top10%)	142		64	67	51	46

This Faculty contributed to more than 2,000 publications with a high impact, at a fairly constant level of around 420 publications per year. The estimated contribution (P') of this Faculty decreased somewhat, which indicates that researchers participated in larger (co-authoring) teams. Both the impact of the research at this Faculty and the impact of the journals in which it is published show a slight decrease over the years.

Figure 4-7 Performance trend (output and impact) of the Faculty of Biological and Environmental Sciences

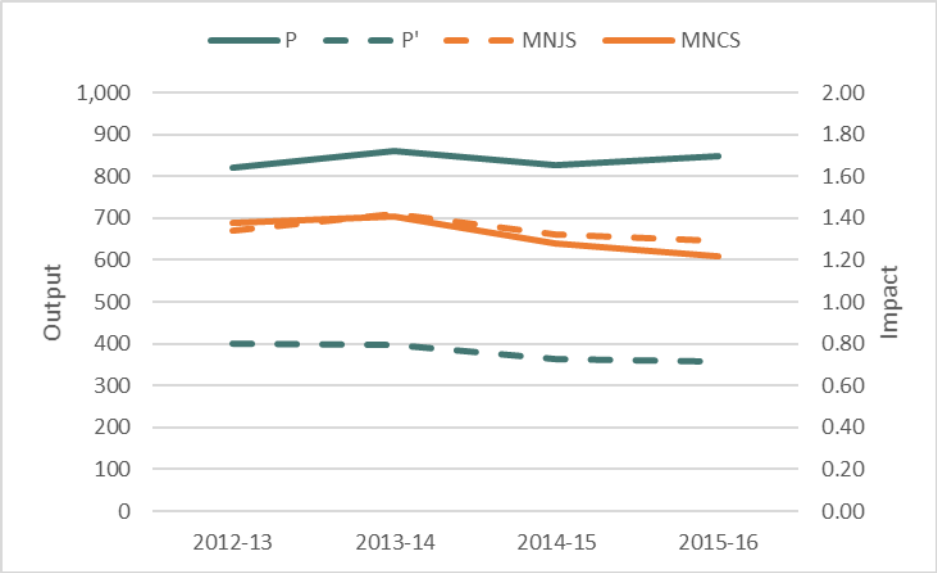


Figure 4-8 Research profile (output and impact) of the Faculty of Biological and Environmental Sciences

WoS field	P	P'	MNCS	MNJS
ECOLOGY	277	120	1.40	1.42
MULTIDISCIPL SC	190	82	1.46	1.68
ENVIRONMENTAL SC	175	80	1.13	1.23
PLANT SCIENCES	124	57	1.61	1.48
EVOLUT BIOLOGY	94	44	1.70	1.62
MARIN&FRESHW BIO	89	41	0.81	0.85
GENETICS&HEREDIT	85	40	1.39	1.43
BIOCHEM&MOL BIOL	85	39	2.55	1.80
MICROBIOLOGY	66	32	1.12	1.30
ZOOLOGY	63	30	0.98	0.90
BIODIV CONSERVAT	43	17	1.18	1.30
GEOSC,MULTIDISC	43	15	1.11	1.24
BIOLOGY	40	21	1.76	1.94
NEUROSCIENCES	37	17	1.50	1.66
CELL BIOLOGY	34	13	1.54	1.53

The research fields of this Faculty are primarily Ecology, Environmental Sciences and Plant Sciences. In these fields the impact is high, and in most cases higher than in any

other field in which it publishes. The majority of publications in multidisciplinary journals are in PLOS ONE.

Figure 4-9 Collaboration profile (output and impact) of the Faculty of Biological and Environmental Sciences

Collaboration	P	MNCS	MNJS
Intl collab	1,275	1.64	1.47
Nat collab	425	1.11	1.20
Single inst	387	1.08	1.23

The Faculty's largest type of output by far is international collaboration, with an impact of more than 60% above world average.

Faculty of Educational Sciences

The internationally esteemed and highly successful Faculty of Educational Sciences in University of Helsinki is Finland's leading unit of research and teaching in Educational Sciences and Teacher Education. The aim of the Faculty's research and teaching is to optimally realise the cultural and social potential of people for the benefit of individuals and humanity.

Source: UH website

Table 4-5 Overall and trend performance 2012-2016 of the Faculty of Educational Sciences

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	1,229		459	523	503	501
P'	556.6		203.5	251.7	237	218
WoS coverage	0.64		0.67	0.65	0.64	0.63
MNJS	1.04		1.10	1.05	1.03	1.02
TCS	2,490		1,518	1,312	863	405
MCS	4.47		7.46	5.21	3.64	1.86
MNCS	1.00		1.06	1.02	1.03	0.95
PP(top10%)	0.10		0.11	0.10	0.10	0.10
P(top10%)	56		22	25	24	22

The Faculty of Educational Sciences contributed to 1,229 publications in 2012-2016 with a stable number of around 250 per year. The estimated contribution decreased somewhat from 2013, which means that researchers were becoming more involved in larger (co-authoring) teams. During the period studied, both the impact of the Faculty and the impact of the journals used decreased slightly to around world average.

Figure 4-10 Performance trend (output and impact) of the Faculty of Educational Sciences

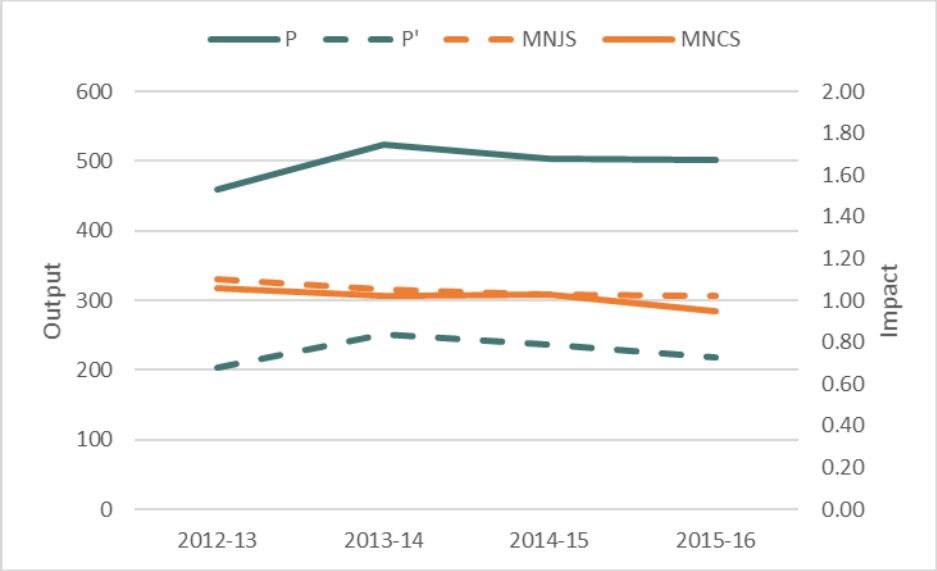


Figure 4-11 Research profile (output and impact) of the Faculty of Educational Sciences

WoS field	P	P'	MNCS	MNJS
EDUCAT&EDUC RES	187	132	0.93	0.90
PSYCHOL,MULTID	127	51	1.14	1.13
NEUROSCIENCES	80	30	0.86	1.04
MULTIDISCIPL SC	79	24	0.91	1.05
PUBL,ENV&OCC HLT	76	24	0.87	0.96
PSYCHIATRY	62	16	0.89	1.16
CLIN NEUROLOGY	34	14	1.12	1.22
PSYCHOL,EXPER	33	19	1.31	1.44
PSYCHOL,SOCIAL	32	19	1.14	1.18
PSYCHOL,DEVELOP	31	13	0.97	0.99
PSYCHOL,EDUCAT	26	14	1.95	1.54
PEDIATRICS	25	9	0.78	1.04
GENETICS&HEREDIT	23	1	1.44	1.43
MEDICINE,GEN&INT	21	2	1.67	1.90
PSYCHOL,CLINIC	19	8	0.92	0.68

Most research at the Faculty is published in journals in the field of Education & Educational Research and Multidisciplinary Psychology. It should be noted that the WoS coverage in the field of Education & Educational Research is much lower than in any of the other categories (0.4 vs 0.7 or higher). This means that that research output in

this category is less well represented than output in other categories. This has an impact on the representativeness of the analysis but does not explain why the impact of this sample is lower.

Figure 4-12 Collaboration profile (output and impact) of the Faculty of Educational Sciences

Collaboration	P	MNCS	MNJS
Intl collab	567	1.16	1.23
Nat collab	393	0.81	0.97
Single inst	269	1.03	0.99

Less than 50% of the output of the Faculty of Educational Sciences involves international collaboration. The impact of this type of collaboration higher than for the other types, as well as the impact of journals used.

Faculty of Medicine

The high quality medical research conducted ranges from biological basic research to clinical applications. During the current strategic period, the Faculty's research focus areas include malignancies, brain and mind, inflammation, metabolism and degenerative processes.

Source: UH website (Faculty of Medicine: research)

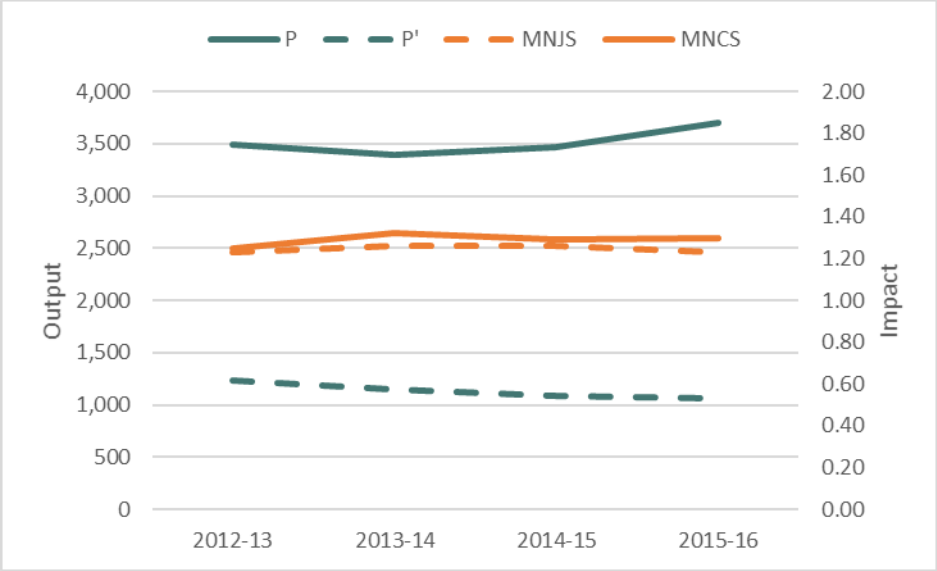
Table 4-6 Overall and trend performance 2012-2016 of the Faculty of Medicine

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	8,851		3,488	3,394	3,468	3,695
P'	2851.5		1239.8	1149.5	1089.2	1061.7
WoS coverage	0.91		0.92	0.92	0.91	0.91
MNJS	1.24		1.23	1.26	1.26	1.23
TCS	29,508		18,321	14,102	9,433	5,345
MCS	10.35		14.78	12.27	8.66	5.03
MNCS	1.28		1.25	1.32	1.29	1.30
PP(top10%)	0.13		0.13	0.14	0.13	0.13
P(top10%)	371		161	161	142	138

The Faculty of Medicine contributed to almost 9,000 publications in 5 years. These publications received more than 10 citations on average. Normalized by field and year, the Faculty has an impact of around 30% above world average. Looking at the trends for this Faculty over time, we see a stable impact. Moreover, researchers in this Faculty manage to be published in high-impact journals (MNJS).

We also observe an increase in the number of publications to which the Faculty contributes. The fraction of its contribution to these publications (P') decreases over time. This means that researchers in medicine increasingly participate in large teams, with many co-authoring partners (c.f., Figure 4-13).

Figure 4-13 Performance trend (output and impact) of the Faculty of Medicine



The research profile of this Faculty contains 30 items rather than 15, due to the large amount of publications it was involved in. The profile of the Faculty of Medicine includes a few fields close to the current strategic focus (e.g., Oncology, Endocrinology & Metabolism, Clinical Neurology, Neuroscience). In these fields, the impact is high and also the Faculty manages to publish in high-impact journals. It should be noted, however, that the rather coarse classification into journal-based fields does not allow more specific linking to the strategic focus. In the case of the most prominent field, i.e., that of Multidisciplinary Science journals, this is even more complicated. The majority of the output in this field is in PLOS ONE.

Figure 4-14 Research profile (output and impact) of the Faculty of Medicine

WoS field	P	P'	MNCS	MNJS
MULTIDISCIPL SC	577	163	1.43	1.26
ONCOLOGY	496	136	1.39	1.30
ENDOCRIN&METABOL	451	107	1.36	1.53
CLIN NEUROLOGY	402	137	1.43	1.28
GENETICS&HEREDIT	362	62	1.70	1.48
SURGERY	329	168	1.21	1.20
PUBL,ENV&OCC HLT	298	97	0.92	0.95
NEUROSCIENCES	297	107	1.14	1.31
MEDICINE,GEN&INT	294	75	3.55	3.34
PEDIATRICS	248	95	0.96	0.93
PSYCHIATRY	240	64	1.18	1.07
CARD&CARDIOV SYS	233	66	1.92	1.55
DENT,ORAL SURG&M	205	72	1.04	0.99
IMMUNOLOGY	202	63	1.13	1.19
GASTROEN&HEPATOL	194	83	1.37	1.27
BIOCHEM&MOL BIOL	191	62	1.34	1.31
OBSTETRICS&GYNEC	189	68	1.13	1.05
PERIPHL VASC DIS	184	58	1.49	1.30
CELL BIOLOGY	164	57	1.46	1.33
PHARMACOL&PHARMA	158	67	1.38	1.33
HEMATOLOGY	148	32	1.34	1.31
UROLOGY&NEPHROL	141	44	1.29	1.31
NUTRITION&DIET	135	44	0.94	0.90
INFEC DISEASE	130	34	1.01	1.03
MICROBIOLOGY	116	40	1.17	1.17
MEDICINE,RES&EXP	113	34	1.51	1.46
VIROLOGY	111	36	1.20	1.02
OTORHINOLARYNGOL	97	41	0.96	0.94
RHEUMATOLOGY	97	22	0.93	0.85
PATHOLOGY	92	30	1.04	0.98

Figure 4-15 Collaboration profile (output and impact) of the Faculty of Medicine

Collaboration	P	MNCS	MNJS
Intl collab	5,163	1.58	1.47
Nat collab	2,731	1.01	1.04
Single inst	957	1.23	1.19

Almost 60% of the output of this Faculty involves international collaboration, while around 10% involves UH only. The impact of international collaboration publications is almost 60% above world average, while the output by 'UH only' has an impact of almost 25% above world average. The impact of journals shows a similar picture.

Faculty of Pharmacy

The Faculty's research activities focus on drugs. The objectives are to identify new drug targets, create and develop new drugs, establish new drug administration methods, examine the pharmacokinetic and pharmacological properties of drugs, develop new technologies, explore social and economic issues involving drug therapy, and educate leading professionals in the field.

Source: UH website (Faculty of Pharmacy: research)

Table 4-7 Overall and trend performance 2012-2016 of the Faculty of Pharmacy

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	773		278	303	326	343
P'	335.1		121	133.2	140.8	148.3
WoS coverage	0.92		0.93	0.92	0.91	0.91
MNJS	1.18		1.20	1.20	1.16	1.16
TCS	2,754		1,538	1,232	999	712
MCS	8.22		12.72	9.26	7.10	4.80
MNCS	1.15		1.19	1.16	1.19	1.13
PP(top10%)	0.12		0.12	0.11	0.13	0.13
P(top10%)	40		15	15	18	19

Both the output in which the Faculty of Pharmacy is involved (P) and its estimated contribution (P') increase over the 2012-2016 period. The impact of the Faculty's research remains at a similar level of around 15-20% above world average. The same holds for the impact of journals in which its research is published.

Figure 4-16 Performance trend (output and impact) of the Faculty of Pharmacy

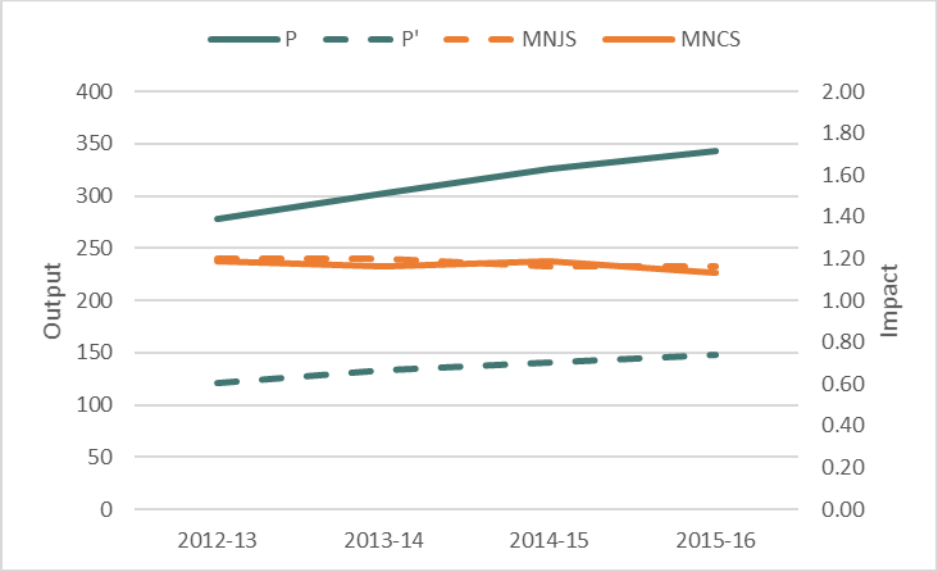


Figure 4-17 Research profile (output and impact) of the Faculty of Pharmacy

WoS field	P	P'	MNCS	MNJS
PHARMACOL&PHARMA	180	86	1.12	1.16
MULTIDISCIPL SC	51	23	1.00	0.86
CHEM,MULTIDISC	44	20	1.16	1.28
CHEM,ANALYTICAL	37	19	0.84	1.14
BIOCHEM&MOL BIOL	35	15	0.90	1.03
CHEM,MEDICINAL	34	15	0.73	0.96
ONCOLOGY	22	7	1.50	1.27
CHEM,PHYSICAL	21	8	1.15	1.25
BIOCHEM RES METH	19	9	0.72	0.88
MATER SC,MULTID	17	6	1.73	1.76
NEUROSCIENCES	16	10	2.07	2.31
MEDICINE,RES&EXP	16	6	1.32	1.18
CELL BIOLOGY	16	6	1.27	1.34
MATER SC,BIOMAT	16	6	3.04	2.54
ENG,BIOMEDICAL	15	5	3.36	2.86

As expected, the research at this Faculty is published in journals in the field of Pharmacology & Pharmacy. Most of the other fields are associated areas involving drug-related research (e.g., Chemistry, Biochemistry). We found very little evidence in

these data of research related to social or economic aspects of drug therapy, but this may also be published in Pharmacy journals, e.g. journals in pharmaeconomics.

Figure 4-18 Collaboration profile (output and impact) of the Faculty of Pharmacy

Collaboration	P	MNCS	MNJS
Intl collab	450	1.30	1.21
Nat collab	214	1.15	1.20
Single inst	109	0.97	1.12

The Faculty of Pharmacy contributes mostly to publications involving international collaboration. This output has the highest impact. Both of the collaboration output types are published in high-impact journals.

Faculty of Science

Scientific expertise is at a high level in Finland. [..] Its strategic areas of research include astronomy, basic environmental research, atmosphere science, nano-science, data science, computational science, mathematical physics, data analysis of biological data, as well as geoinformatics, geosciences, and urban research.

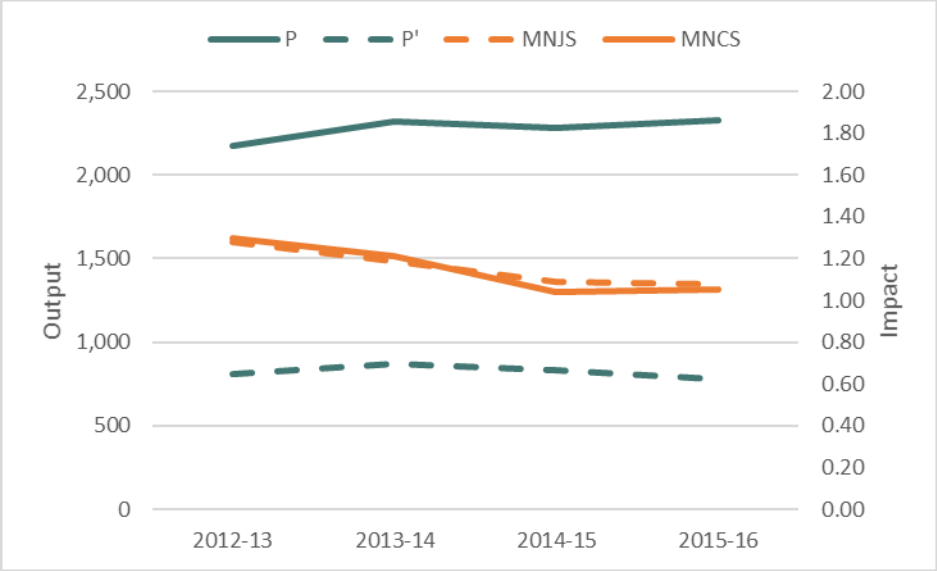
Source: UH website (Faculty of Science: research)

Table 4-8 Overall and trend performance 2012-2016 of the Faculty of Science

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	5,681		2,172	2,324	2,284	2,329
P'	2027.3		810.9	867.8	830.4	777.6
WoS coverage	0.83		0.83	0.83	0.83	0.82
MNJS	1.17		1.28	1.19	1.09	1.08
TCS	14,786		9,304	7,417	4,568	2,517
MCS	7.29		11.47	8.55	5.50	3.24
MNCS	1.16		1.30	1.21	1.04	1.05
PP(top10%)	0.12		0.13	0.12	0.10	0.11
P(top10%)	243		105	104	83	86

This Faculty was involved in 5,681 articles and reviews in 2012-2016, with the number of publications (P) increasing over the years. The estimated contribution to this output (P') is, however, slightly decreasing. This means that researchers in this Faculty are becoming involved in larger co-authoring teams. The impact of this Faculty decreases in the first three years and stabilizes at just above world average in the most recent years. The impact of journals in which its research is published shows the same trend as the impact of the Faculty.

Figure 4-19 Performance trend (output and impact) of the Faculty of Science



This Faculty's mission, as presented in the description of the Faculty on the UH website, shows a wide variety of focus areas, and this can also be derived from the research profile (top 30 categories). There is a clear preference for Astronomy & Astrophysics, Particle & Field Physics, and Meteorology & Atmospheric Sciences journals, but additionally a diverse set of related fields can be seen, mostly related to the mission. The enabling focal areas of, for instance, Data Science and Computer Science was published most likely in conference proceedings (i.e., not in WoS journals) and is therefore not covered in this study.

Three out of four publications involve international collaboration. This proportion has increased during the period of analysis, as the teams have become larger (P vs. P'). The impact of journals used and the impact of the Faculty are the highest in this category of collaboration output.

Figure 4-20 Research profile (output and impact) of the Faculty of Science

WoS field	P	P'	MNCS	MNJS
ASTRON&ASTROPH	693	134	1.05	1.15
PHYSICS,PART&FIE	572	78	1.11	1.14
METEOR&ATMOS SC	425	131	0.97	1.16
MATHEMATICS	238	143	1.45	1.35
PHYSICS,NUCLEAR	235	51	0.89	0.81
PHYSICS,MULTIDIS	233	40	2.98	2.82
ENVIRONMENTAL SC	179	71	0.79	0.83
CHEM,PHYSICAL	164	80	1.37	1.29
MULTIDISCIPL SC	161	44	2.33	2.43
GEOSC,MULTIDISC	160	56	0.97	1.04
CHEM,MULTIDISC	131	63	1.22	1.32
PHYSICS,AT,MO&CH	118	57	1.06	0.97
MATH,APPLIED	99	53	0.90	1.01
ECOLOGY	94	40	1.54	1.42
GEOCHEM&GEOPHYS	89	34	1.09	1.03
MATER SC,MULTID	87	38	1.67	1.46
PHYSICS,COND MAT	85	43	1.12	1.10
PHYSICS,APPLIED	81	38	1.70	0.78
CHEM,ORGANIC	74	34	0.66	0.80
PHYSICS,MATHEMAT	73	38	1.23	1.34
CHEM,INORG&NUCL	64	32	0.99	0.84
POLYMER SCIENCE	57	32	0.97	0.89
GEOGRAPHY,PHYSIC	55	21	1.00	1.06
CHEM,ANALYTICAL	54	29	1.16	1.06
NUCL SC&TECHNOL	51	23	0.81	0.75
OPTICS	49	19	1.01	0.96
INSTRUM&INSTRUME	49	16	0.78	0.73
BIOCHEM RES METH	37	18	1.16	1.59
COMP SC,AI	35	15	1.02	0.96
ENG,ELEC&ELECTR	35	16	1.01	1.33

Figure 4-21 Collaboration profile (output and impact) of the Faculty of Science

Collaboration	P	MNCS	MNJS
Intl collab	4,207	1.24	1.23
Nat collab	753	1.08	1.07
Single inst	721	1.09	1.13

Faculty of Social Sciences

The Faculty of Social Sciences conducts advanced social scientific research that explores phenomena and problems in our changing world from global, European, national and local perspectives.

Source: UH website (Faculty of Social Sciences: research)

Table 4-9 Overall and trend performance 2012-2016 of the Faculty of Social Sciences

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	923		340	405	367	376
P'	549.6		216.6	244.3	211.1	212.2
WoS coverage	0.49		0.50	0.48	0.50	0.48
MNJS	0.99		1.13	1.12	0.96	0.83
TCS	1,901		1,267	919	527	251
MCS	3.46		5.85	3.77	2.50	1.19
MNCS	0.87		0.97	0.91	0.79	0.75
PP(top10%)	0.08		0.10	0.08	0.06	0.07
P(top10%)	44		22	20	13	15

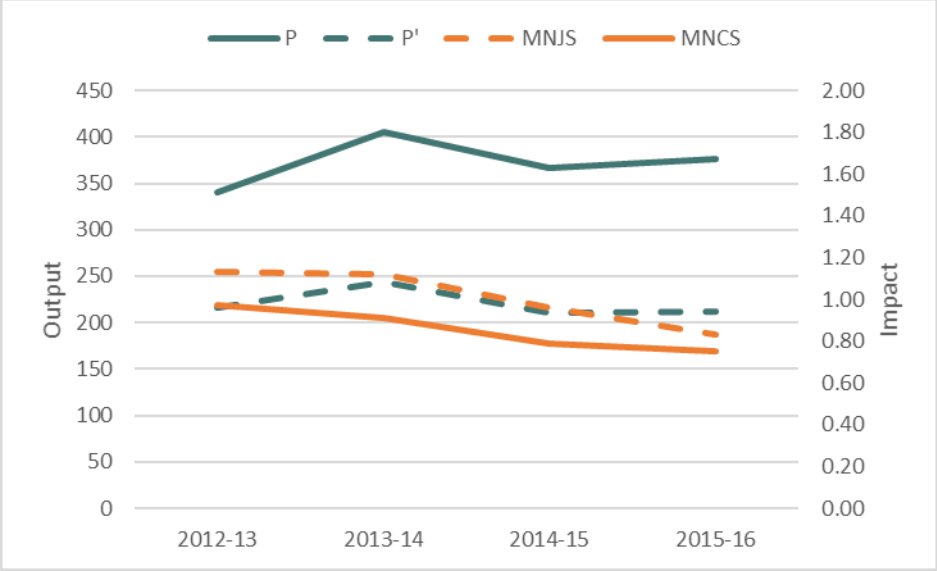
The Faculty of Social Sciences contributed to almost a thousand publications in the 2012-2016 period. The number fluctuates between 170 and 200 per year. The estimated contribution (P') of this Faculty shows the same trend.

The WoS coverage level of this Faculty's research is 50%, according to the IC indicator, therefore the conclusions that we draw from the data may not entirely represent its output and impact. Within the different categories (fields) the IC varies. For the most important field Public, Environmental & Occupational Health, for instance the IC is 0.75, while for Communication it is 0.29. The number of publications is rather low, though, in almost all fields. Furthermore, we note that the impact indicators (MNJS, MNCS and PP[top10%]) should not be affected by the coverage issue; here the impact is compared with the impact of similar output, i.e., with the same WoS coverage issue.

The impact of this Faculty is below the impact of the journals used. This means that researchers in this Faculty manage to publish in journals with higher impact than they

achieve themselves. Both of the impact values (MNCS and PP[top10%]) decrease over the period 2012-2016.

Figure 4-22 Performance trend (output and impact) of the Faculty of Social Sciences



The mission as presented in the description of this Faculty on the UH website is rather general which may lead to the conclusion that the activity in many fields would match. Still, we consider Public, Environmental & Occupational Health a field where one may expect output from a Faculty with that mission. The impact of the Faculty in this field is above world average and also above the overall average of the Faculty.

Figure 4-23 Research profile (output and impact) of the Faculty of Social Sciences

WoS field	P	P'	MNCS	MNJS
PUBL,ENV&OCC HLT	118	49	1.04	1.09
ECONOMICS	42	29	0.76	0.73
PSYCHOL,MULTID	40	23	0.66	0.88
PSYCHOL,SOCIAL	40	30	0.82	0.87
SOCIOLOGY	34	25	0.78	0.87
COMMUNICATION	32	22	0.84	0.80
MULTIDISCIPL SC	29	8	0.74	1.16
HISTO&PHILOS SC	28	23	1.48	1.35
PHILOSOPHY	26	23	0.61	0.77
SUBSTANCE ABUSE	24	15	0.74	0.79
POLITICAL SC	24	16	0.74	0.86
DEMOGRAPHY	21	11	1.46	1.83
SOC SC,BIOMEDIC	20	12	0.72	0.77
SOC SC,INTERDIS	20	14	0.61	0.69
CRIMINOL&PENOL	15	11	0.20	0.96

Figure 4-24 Collaboration profile (output and impact) of the Faculty of Social Sciences

Collaboration	P	MNCS	MNJS
Intl collab	366	1.04	1.15
Nat collab	206	0.87	1.00
Single inst	351	0.82	0.93

The Faculty of Social Sciences has almost as many publications without other (co-authoring) partners as output involving international collaboration. This is common practice in social sciences. The impact of the latter is higher and above world average.

Faculty of Veterinary Medicine

The Faculty of Veterinary Medicine has a strong profile in animal health care and wellbeing as well as food safety. The Faculty is Finland's most important veterinary expert body in both research and teaching.

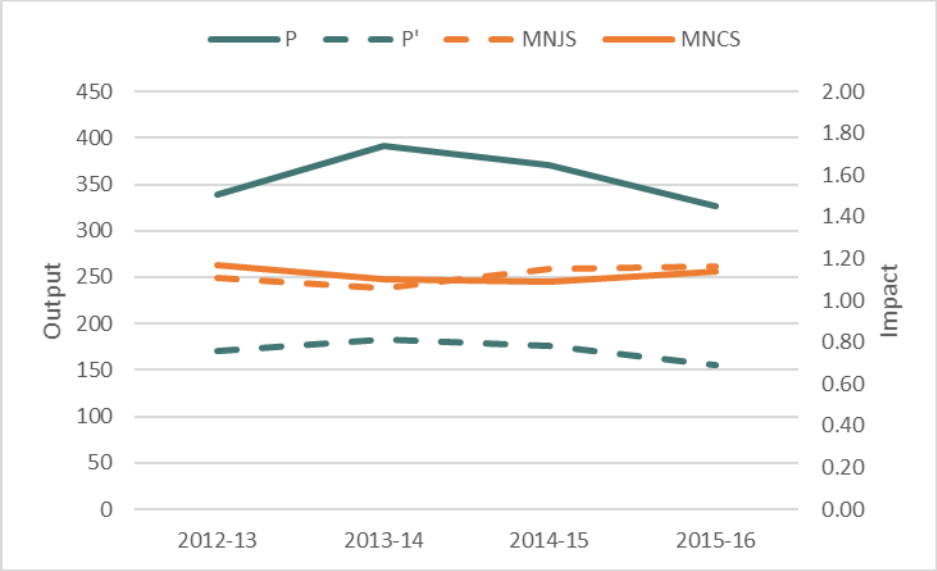
Source: UH website (Faculty of Veterinary Medicine: research)

Table 4-10 Overall and trend performance 2012-2016 of the Faculty of Veterinary Medicine

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	881		339	392	371	327
P'	425.1		170.1	183.5	176	155.7
WoS coverage	0.90		0.90	0.90	0.90	0.89
MNJS	1.11		1.11	1.06	1.15	1.16
TCS	3,488		2,147	1,764	1,158	594
MCS	8.20		12.63	9.61	6.58	3.82
MNCS	1.12		1.17	1.10	1.09	1.14
PP(top10%)	0.10		0.12	0.11	0.09	0.09
P(top10%)	43		20	20	16	14

The Faculty of Veterinary Medicine's output has decreased (P) since 2013. The estimated contribution (P') follows the same trend. In total this Faculty was involved in 881 publications. The impact of journals in which it publishes and the impact of the Faculty are stable over time and slightly above world average. The fact that MNCS is above world average and PP(top10%) is below the expected value of 0.1 means that a small number of this Faculty's publications receive many citations, which has a positive effect on MNCS but not so much on PP(top10%).

Figure 4-25 Performance trend (output and impact) of the Faculty of Veterinary Medicine



Most of this Faculty's output is in Veterinary Sciences and Microbiology journals. In the latter, the impact of both the Faculty and the journals is well above world average. We also observe high impact of the output in Food S&T journals, which closely matches the mission (as presented in the description of the Faculty on the UH website) on food safety.

Figure 4-26 Research profile (output and impact) of the Faculty of Veterinary Medicine

WoS field	P	P'	MNCS	MNJS
VETERINARY SC	199	104	0.98	0.95
MICROBIOLOGY	103	56	1.21	1.19
MULTIDISCIPL SC	82	29	1.21	1.26
FOOD SC&TECHNOL	54	35	1.31	1.35
BIOTECH&APPL MIC	52	27	1.48	1.24
VIROLOGY	34	13	1.14	1.08
INFEC DISEASE	33	13	0.95	0.99
AGRIC,DAIRY&ANIM	30	19	1.43	1.10
GENETICS&HEREDIT	23	7	1.27	1.26
PHARMACOL&PHARMA	22	9	1.29	1.57
GASTROEN&HEPATOL	21	7	2.65	2.16
BIOCHEM RES METH	17	7	1.59	1.45
BIOCHEM&MOL BIOL	16	7	0.72	0.74
PUBL,ENV&OCC HLT	13	5	0.51	0.57
NEUROSCIENCES	13	7	0.42	0.88

Figure 4-27 Collaboration profile (output and impact) of the Faculty of Veterinary Medicine

Collaboration	P	MNCS	MNJS
Intl collab	504	1.30	1.25
Nat collab	170	1.07	1.07
Single inst	207	1.01	1.02

This Faculty's research primarily involves international collaboration (58%) with high impact. This research is also published in high-impact journals.

HiLIFE (BI, FIMM, NC)

The University of Helsinki has broad strengths in Life Sciences as exemplified by the themes presented here. HiLIFE enhances top research through excellence-only calls and stimulates new ideas at edges of fields to provide solutions to grand challenges in multidisciplinary collaborations. The HiLIFE Fellows program aims to nurture excellence and increase interactions among researchers from different fields of life science. The Fellows will help in developing HiLIFE in its early steps. HiLIFE Research Programs are initiating in 2018.

Source: UH website (HiLIFE: research)

Table 4-11 Overall and trend performance 2012-2016 of HiLIFE

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	1,937		759	755	755	794
P'	677.7		285.5	281.2	265.8	253.5
WoS coverage	0.94		0.95	0.95	0.94	0.94
MNJS	1.39		1.47	1.44	1.37	1.29
TCS	9,364		5,917	4,562	3,003	1,372
MCS	13.82		20.73	16.22	11.30	5.41
MNCS	1.42		1.54	1.51	1.37	1.21
PP(top10%)	0.17		0.20	0.19	0.15	0.12
P(top10%)	115		57	53	40	30

Helsinki Institute of Life Science HiLIFE was established in 2017 as a unit integrating and highlighting life science across the university. It supports research at partner faculties (Agriculture and Forestry, Biological and Environmental Sciences, Medicine, Pharmacy, Science, and Veterinary Medicine), and within its operative units (Institute of Biotechnology; Institute for Molecular Medicine Finland and Neuroscience Center). HiLIFE also coordinates research infrastructures in life sciences and provides research-based interdisciplinary training.

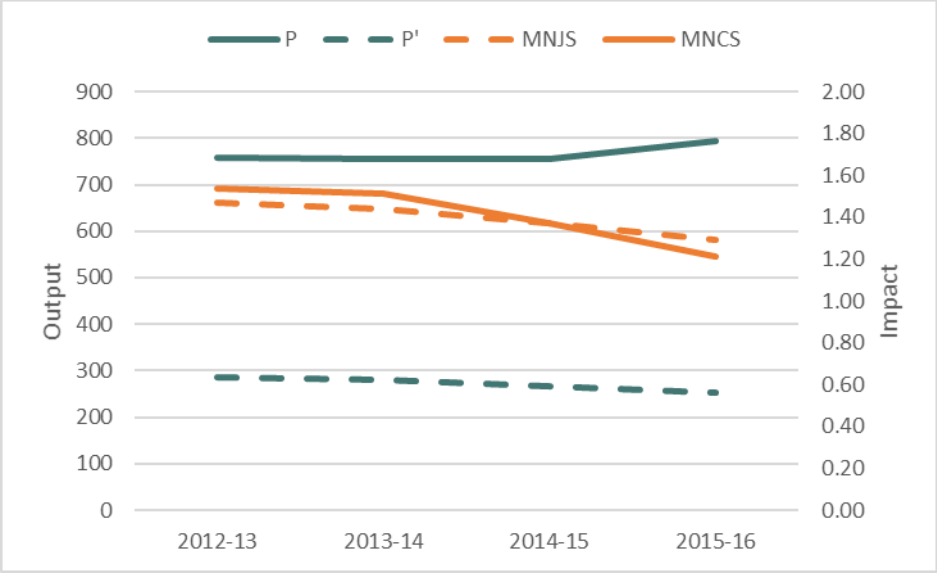
The current analysis extends to 2012, five years before establishing HiLIFE. To provide a coherent view over the time window, this analysis is limited to the operative units. Publications have been collected by affiliation: a publication is included in the analysis when at least one author is affiliated to one of the three operative units of HiLIFE (BI, FIMM or NC).

HiLIFE contributed to almost 2,000 articles and reviews in the period studied. The number of publications increased somewhat, while the estimated contribution decreased slightly, because the Institute participated in larger teams.

The impact of both the Institute and the journals in which it publishes decreased over the years. HiLIFE's impact decreased from 1.5 to 1.2 MNCS, and 0.2 to 0.12 PP(top10%) but is still at a high level.

It should be noted that the estimated WoS coverage of HiLIFE's research is very high. The sample of WoS publications is therefore a good representation of its work. Finally, it is noteworthy that more than 60% of HiLIFE's research is published OA (see: Section 0).

Figure 4-28 Performance trend (output and impact) of HiLIFE



HiLIFE's research is published mostly in journals of the fields representing the focus of the three sub-institutes: Genetics & Heredity, Biochemistry & Molecular Biology, and Neurosciences. The impact of HiLife in these fields is very high, while the impact of the journals in which the research is published is also very high.

Almost 70% of HiLIFE's output involves international collaboration. This type of output and the output of research involving only HiLIFE have the highest impact.

Figure 4-29 Research profile (output and impact) of HiLIFE

WoS field	P	P'	MNCS	MNJS
MULTIDISCIPL SC	270	89	1.53	1.53
GENETICS&HEREDIT	203	37	1.76	1.71
BIOCHEM&MOL BIOL	151	64	1.74	1.35
NEUROSCIENCES	133	56	1.51	1.66
CELL BIOLOGY	126	58	1.74	1.58
ONCOLOGY	71	20	1.08	1.20
ENDOCRIN&METABOL	69	13	1.58	1.67
BIOCHEM RES METH	60	26	1.00	1.03
CLIN NEUROLOGY	49	12	1.86	1.67
MICROBIOLOGY	47	26	1.12	1.36
VIROLOGY	46	23	1.05	1.02
PSYCHIATRY	41	8	1.46	1.33
BIOTECH&APPL MIC	39	19	1.16	1.06
DEVELOPMENT BIOL	37	20	1.85	1.57
PHARMACOL&PHARMA	34	17	1.29	1.56

Figure 4-30 Collaboration profile (output and impact) of HiLIFE

Collaboration	P	MNCS	MNJS
Intl collab	1,344	1.66	1.54
Nat collab	328	1.02	1.05
Single inst	265	1.33	1.39

By HiLIFE institute

In the remainder of this section, we will look in parallel at the three HiLIFE institutes: the Institute of Biotechnology (BI), the Institute of Molecular Medicine Finland (FIMM), and the Neuroscience Center (NC). The table below presents the general statistics. It shows that BI and FIMM are involved in the most publications. All three institutes manage to publish their research in high-impact journals. Moreover, the impact of all three is high. It should be mentioned, however, that the impact of all three has also declined in the most recent period, although still at a high level (by both MNCS and PP[top10%]).

Table 4-12 Overall performance 2012-2016 of the 3 HiLIFE institutes

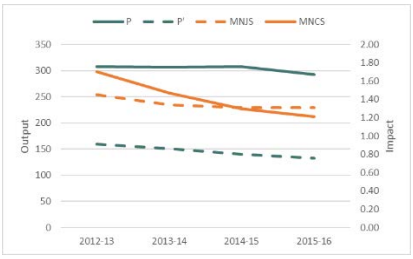
Indicator	BI	FIMM	NC
P	749	963	296
P'	363	201	135.8
WoS coverage	0.94	0.93	0.96
MNJS	1.37	1.37	1.48
TCS	5,404	2,481	1,796
MCS	14.89	12.34	13.22
MNCS	1.48	1.34	1.39
PP(top10%)	0.17	0.15	0.17
P(top10%)	62	30	23

As mentioned above, the three institutes naturally have their own focus, which is illustrated by their research profiles (Figure 4-31). In the fields on which they focus individually, the impact of their research is high. We further note that an institute's impact in another's focus field may be low. For instance, the research focus of BI is Biochemistry & Molecular Biology and it has high impact in this, whereas FIMM's impact in this field is just above average and NC's is low. In that sense, the institutes appear to work in complementary fields. We see the same in the field of Genetics & Heredity

when we compare FIMM and BI,[1] and likewise in Neurosciences, where NC's impact is high, FIMM's is world average, and BI's is just above average.

Figure 4-31 Output and impact by HiLIFE institute (2012-2016)

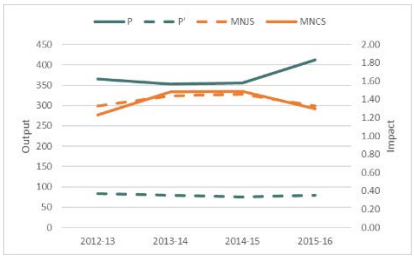
Institute of Biotechnology (BI)



WoS field	P	P'	MNCS	MNJS
MULTIDISCIPL SC	113	49	1.71	1.72
BIOCHEM&MOL BIOL	99	48	2.02	1.43
CELL BIOLOGY	77	41	1.91	1.69
MICROBIOLOGY	45	26	1.10	1.37
VIROLOGY	44	23	1.04	1.01
GENETICS&HEREDIT	37	16	0.86	0.92
BIOCHEM RES METH	32	17	1.16	1.16
DEVELOPMENT BIOL	32	17	1.92	1.65
PLANT SCIENCES	30	14	1.99	1.85
BIOTECH&APPL MIC	21	13	1.22	1.11
BIOPHYSICS	18	11	0.79	0.93
NEUROSCIENCES	16	6	1.18	1.07
IMMUNOLOGY	14	5	1.26	1.25
EVOLUT BIOLOGY	13	5	1.17	1.21
ONCOLOGY	12	5	0.78	0.90

Collaboration	P	MNCS	MNJS
Intl collab	454	1.76	1.50
Nat collab	126	1.13	1.12
Single inst	169	1.35	1.34

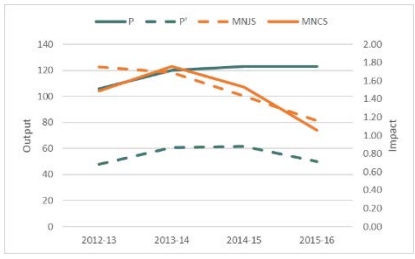
Institute for Molecular Medicine Finland (FIMM)



WoS field	P	P'	MNCS	MNJS
GENETICS&HEREDIT	158	19	2.33	2.20
MULTIDISCIPL SC	133	25	1.55	1.47
ENDOCRIN&METABOL	64	11	1.53	1.65
ONCOLOGY	62	16	1.15	1.27
BIOCHEM&MOL BIOL	45	11	1.05	1.19
CELL BIOLOGY	41	12	1.51	1.39
PUBL,ENV&OCC HLT	32	5	0.93	1.03
NEUROSCIENCES	32	6	1.01	1.25
PSYCHIATRY	32	5	1.23	1.13
MEDICINE,GEN&INT	30	4	2.72	3.24
BIOCHEM RES METH	27	9	0.80	0.79
CLIN NEUROLOGY	27	6	1.86	1.75
CARD&CARDIOV SYS	19	3	1.07	1.33
PERIPHL VASC DIS	17	2	1.59	1.46
BIOTECH&APPL MIC	17	5	1.02	0.99

Collaboration	P	MNCS	MNJS
Intl collab	757	1.57	1.58
Nat collab	170	0.92	0.98
Single inst	36	1.22	1.30

Neuroscience Center



WoS field	P	P'	MNCS	MNJS
NEUROSCIENCES	93	46	1.58	1.75
MULTIDISCIPL SC	30	17	0.99	1.04
CLIN NEUROLOGY	26	7	1.60	1.54
CELL BIOLOGY	19	9	1.06	1.25
GENETICS&HEREDIT	19	3	5.03	3.52
PHARMACOL&PHARMA	13	8	1.75	1.97
BIOCHEM&MOL BIOL	12	7	0.62	0.92
PSYCHIATRY	9	4	1.66	1.52
BIOLOGY	5	3	0.55	0.99
BIOCHEM RES METH	5	3	0.24	0.54
BEHAVIORAL SC	5	3	1.89	2.28
DEVELOPMENT BIOL	5	2	1.12	1.01
RAD,NUCL MED IM	5	2	1.24	1.06
PSYCHOL,MULTID	4	2	1.07	0.93
MEDICINE,RES&EXP	4	1	2.11	2.52

Collaboration	P	MNCS	MNJS
Intl collab	185	1.45	1.49
Nat collab	45	0.96	1.03
Single inst	66	1.46	1.59

The collaboration profiles show that FIMM has the highest output involving international collaboration (79% vs 61% and 63%). The impact of this research is very high in all three institutes. Also, the journals in which this international output is published have a very high impact. The research involving national collaboration is found to have a lower impact.

[1] The impact of NC in this field is high, but its output in this field is low.

Finnish Museum of Natural History LUOMUS

At the core of the research done at the Finnish Museum of Natural History, Luomus, are those principal branches of science that specialize in depicting species accurately. These branches are closely connected to research on evolution and the diversity of nature. Other central branches of research at Luomus include biogeography, the geology of Earth history and research based on biological monitoring data and dating techniques. Luomus has also strengthened its participation in climate change research. […] Additionally, for example, the monitoring data from birds have been utilized in studies which study organisms' reactions to the changing climate.

Source: LUOMUS website: research

Table 4-13 Overall and trend performance 2012-2016 of the Finnish Museum of Natural History LUOMUS

Indicator	2012-16		2012-13	2013-14	2014-15	2015-16
P	512		181	231	234	199
P'	219.5		80.6	101.8	105.3	78.7
WoS coverage	0.65		0.65	0.65	0.63	0.65
MNJS	1.01		1.15	0.95	0.89	0.93
TCS	1,112		759	478	310	136
MCS	5.07		9.42	4.69	2.95	1.73
MNCS	0.92		1.25	0.85	0.69	0.73
PP(top10%)	0.07		0.10	0.07	0.04	0.04
P(top10%)	15		8	7	4	3

The number of publications in which the independent UH institute LUOMUS was involved is 512 in the period 2012-2016, around 100 per year. After 2013 the output in which it was involved increased, while the impact decreased to a level below world average. Considering the mission of LUOMUS (as presented in the description on the UH website), being connected and supportive to science, rather than leading, this is not necessarily surprising nor worrying.

Figure 4-32 Performance trend (output and impact) of the Finnish Museum of Natural History LUOMUS

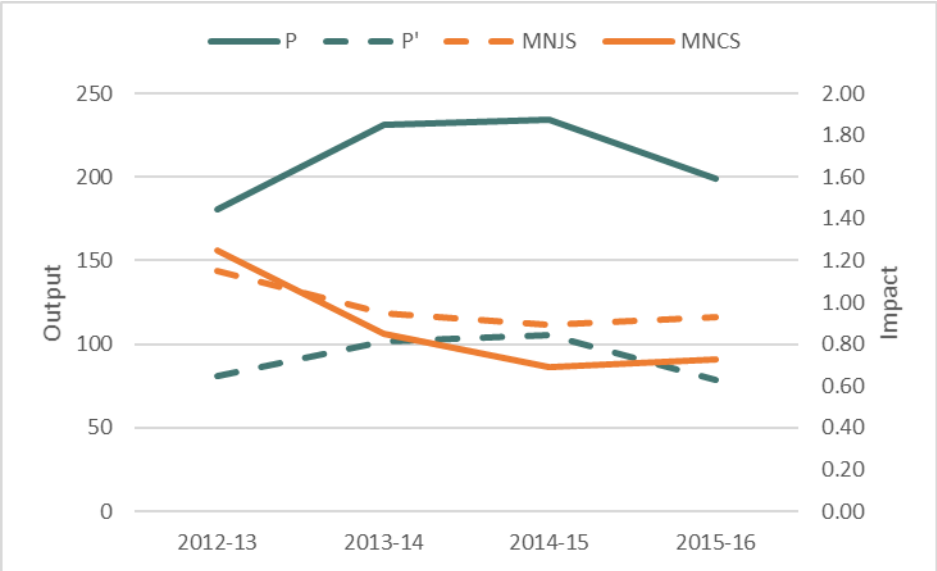


Figure 4-33 Research profile (output and impact) of the Finnish Museum of Natural History LUOMUS

WoS field	P	P'	MNCS	MNJS
PLANT SCIENCES	80	36	0.81	0.75
ZOOLOGY	79	48	0.56	0.64
ECOLOGY	55	19	1.22	1.31
MYCOLOGY	41	18	0.64	0.70
EVOLUT BIOLOGY	33	11	1.33	1.63
MULTIDISCIPL SC	28	8	4.40	3.15
ENTOMOLOGY	26	13	0.32	0.41
ORNITHOLOGY	24	8	1.20	1.07
ENVIRONMENTAL SC	18	7	0.74	1.33
GEOCHEM&GEOPHYS	18	8	0.55	1.02
BIODIV CONSERVAT	15	5	0.88	1.32
GEOSC,MULTIDISC	11	4	0.73	0.99
GENETICS&HEREDIT	9	3	1.16	1.44
PARASITOLOGY	8	2	1.48	2.19
GEOGRAPHY,PHYSIC	7	3	0.50	1.20

The research output focuses on Plant Sciences, Zoology and Ecology. These fields closely match the focus stated in the mission as presented in the description of the

Faculty on the UH website. The impact of its research is not very high but, considering its mission in general, this should not be viewed as a problem. The research output involving international collaboration has high impact. This indicates that it contributes substantially to international research projects.

Figure 4-34 Collaboration profile (output and impact) of the Finnish Museum of Natural History LUOMUS

Collaboration	P	MNCS	MNJS
Intl collab	337	1.35	1.26
Nat collab	97	0.88	0.98
Single inst	78	0.40	0.70

5. Main findings

In this report, we present the results of the performance assessment of the University of Helsinki by bibliometric measures. Publication data were collected by faculty and analyzed by state-of-the-art bibliometric methods and indicators, using a dedicated Web of Science (WoS) database developed at CWTS. The impact calculated by citations is used as a proxy for quality of the research at the UH faculties.

We counted almost 22,000 publications in WoS for UH in the period 2012-2016. Almost 85% of the output is done in collaboration with other organizations, while more than 60% involves international collaboration. Approximately 80% of UH's scientific output is covered by WoS but here are large differences among faculties. While HiLIFE is covered with almost 95%, the faculty of Social Sciences is represented with 49% of their total scientific output. The Faculties of Medicine and Science are by far the most productive as measured by the number of publications in which they were involved. The Faculty of Medicine is involved in 40% of the total output of UH, while the Faculty of Science is involved in more than 25%.

In a dedicated analysis of the output of UH, we found *PLOS ONE*, *Physical Review D*, *Astronomy & Astrophysics*, *Journal of High Energy Physics*, *Atmospheric Chemistry & Physics*, *Physics Letters B*, *Physical Review Letters* and *Scientific Reports* to be the most popular channels. All these journals have a citation impact at or above world average. *Physical Review Letters* has an impact of more than twice the world average. Measuring for all journals UH published in, we found the impact to be 17% above world average. This means that UH researchers manage to get their work published in high impact journals.

With almost 69,000 citations in total until 2017, a UH publication received on average almost 8 citations. Normalized by field, the University has an impact (MNCS) of almost 20% more than world average in the period of analysis (2012-2016). The proportion of publications in the top 10% most highly cited ones (PP[top10%]) is 20% higher than expected.

The impact as measured by MNCS varies among faculties between 0.87 and 1.48. Particularly, the interpretation of the lower impact of some faculties needs to be interpreted with great care, as in those cases we also found that the coverage of WoS is lower than in most other. Hence, the impact is measured on a smaller sample of the faculty's total output and with most likely not all relevant literature (potential citers) included.

Another difference among faculties we found regards the share of output co-authored with other organizations. In the Faculty of Social Science for instance the proportion of output co-authored with other organizations is just above 60%, while 2 out of 5 publications involves international collaboration. The Faculty of Science co-authors almost 90% of their output with other organization, while almost 75% involves organizations from other countries. The higher percentage of output in collaboration with foreign organizations often leads to higher impact.

There is quite some variation among faculties in the level of detail of the research missions that were available for this work (extracted from the UH website). However, in most cases there is a match between the high-impact fields of research and the focus as described.

Annex A: Indicators

In the report we presented the results of the following indicators for each unit analyzed.

- Number of publications (**P**) in international journals of the unit analyzed in the period. A publication must be covered by Web of Science and as such be identified as an article or review.
- Number of publications (**P'**) in international journals of the unit analyzed in the period, weighted by the number of co-authoring organizations.
- Number of citations received by P during the entire period, excluding author self-citations (**TCS**). We count citations up to 2017, regardless of the year in which a paper is published.
- The average number of citations without self-citations per paper (**MCS**) and in a period of maximum four years after publication.
- The mean normalized citation score (**MNCS**) relates the MCS of each publication to the research area to which it belongs. Traditionally, the actual number of citations (without self-citations) is divided by the expected number of citations on a per-paper basis. Here, the expected number of citations is based on the world-wide average citation score without self-citations of all similar papers in the same research area (see below) and year (i.e., with the same citation window). Next, the MNCS indicator is computed for each unit analyzed, by taking the average of these areas' normalized citation scores for individual papers. A value above 1 indicates that the unit's mean impact is above world average, whereas a value below 1 indicates the opposite.
- The mean normalized journal score (**MNJS**) indicates the average citation impact of the journals that published the papers of the unit analyzed. The indicator is calculated on the basis of the same principles as the MNCS. It shows whether the publications originating from the unit analyzed were published in top or sub-top (in terms of citation impact) journals.
- The proportion of highly cited publications (**PP[top10%]**): the proportion of a unit's publications in the top 10th percentile of the citation distribution for papers in the same field (see below). The world average, or expected value, is 0.10. A unit with a PP(top10%) of 0.12 has 20% more publications in the top 10% than expected or 20% above world average.
- The proportion of a unit's publications that were co-authored with at least one organization from another country (**PP[intl collab]**).

- The proportion of a unit's publications that were co-authored with at least one other organization (**PP[collab]**).
- The proportion of a unit's publications that were co-authored with at least one company in industry (**PP[industry]**).
- The internal coverage (**IC** or **IntCov**) is a proxy for how well WoS covers the field in which the University of Helsinki (or its faculty) publishes. This proxy is based on the assumption that researchers cite relevant work. The measure is an average per publication of references that are covered by WoS.

Annex B: Publication-based classification

The CWTS citation database is a bibliometric version of Web of Science (WoS). One of the special features of this database is the publication-based classification. This classification is an alternative for the WoS journal classification, the WoS subject categories. We developed this publication-based classification because of the problems we encounter when using the journal classification for particular purposes, the most prominent of which are the following.

Journal scope (including multidisciplinary journals)

A journal-based classification defines sets of journals to represent a class, in this case a subject category. This implies that journals within a class have a similar scope. They do not need to be comparable with regard to size (number of articles per year) but they should represent a similar specialization or discipline. This is, however, not the case in practice. Individual journals may represent a very broad spectrum. There are specialized journals (e.g., *Scientometrics*) and very general ones (e.g., *Nature* or *Science* but also *British Medical Journal* and *Lancet*). A journal-based classification scheme can therefore not be highly specialized. In Web of Science, the subject category Multidisciplinary includes journals with a broad scope (i.e., journals with publications from many different disciplines). Hence, using this classification, a bibliometric analysis of, for instance, the *Social Sciences* or *Nanotechnology* will not consider papers in Multidisciplinary journals, e.g., *Nature*, *Science*, *PLOS ONE*.

Granularity of the WoS subject categories

The WoS journal classification scheme contains 250 elements. As such, it is a stable system. In many cases, however, it appears that these 250 subject categories are insufficient to be used for proper field analyses, and the problem is that the granularity of the system looks somewhat arbitrary. Biochemistry & Molecular Biology on the one hand and Ornithology on the other, for instance, represent rather different aggregates of research. This is illustrated by the number of journals in each of them. Whereas the Biochemistry & Molecular Biology category contains almost 500 journals, Ornithology has only 27. Although we acknowledge that no granularity is perfect, we would argue that in the WoS subject categories the differences are really too great. A classification based on more objective grounds does not solve this problem but at least it is transparent.

Multiple assignment of journals to categories

In journal classifications from multidisciplinary databases, journals are assigned to more than one category (with maximum of six). Journals often have broader scopes than the categories 'allow'. Here too there are large differences between categories. In the example we used before, Biochemistry & Molecular Biology, the average of the number of categories is close to 2. This means that (on average) each journal in this category is also assigned to one other category. For the more specialized category of Ornithology, the average is 1. This means that in this category all journals are assigned to this one only. If publications in journals with a multiple assignment always covered the categories at stake, this would not necessarily be a problem. However, mostly it means that such journals structurally contain publications from the different categories. Therefore, publications may be assigned to two categories although they belong to just one of them.

The CWTS publication-based classification scheme

In this paragraph we describe a publication level classification we use in this study to normalize cation impact of individual publications.

An advanced alternative for the Web of Science journal classification has been developed at CWTS. It counters three major issues:

1. Journal scope (including multidisciplinary journals)
2. Granularity of the WoS subject categories
3. Multiple assignment of journals to categories

Publications on a specialty that are published in a multidisciplinary journal will now be grouped with publications on a similar specialty and not be allocated to a class that includes all publications from multidisciplinary journals.

The CWTS publication-based classification was developed at CWTS (Waltman & van Eck, 2012). Since the first version, there have been yearly updates of the system. The main characteristics of the classification are as follows.

Publication-to-publication citation clustering

Clusters of publications are created on the basis of citations from one publication to another. More than 25 million publications have been processed. The clusters contain publications from multiple years (2000-2017). Each publication is assigned to only one cluster at each level. A cluster is considered to be – and in many cases has been validated as – representative of disciplines, fields, sub-fields or research areas. For

each cluster, we can calculate growth indices pointing at changing research foci over time.

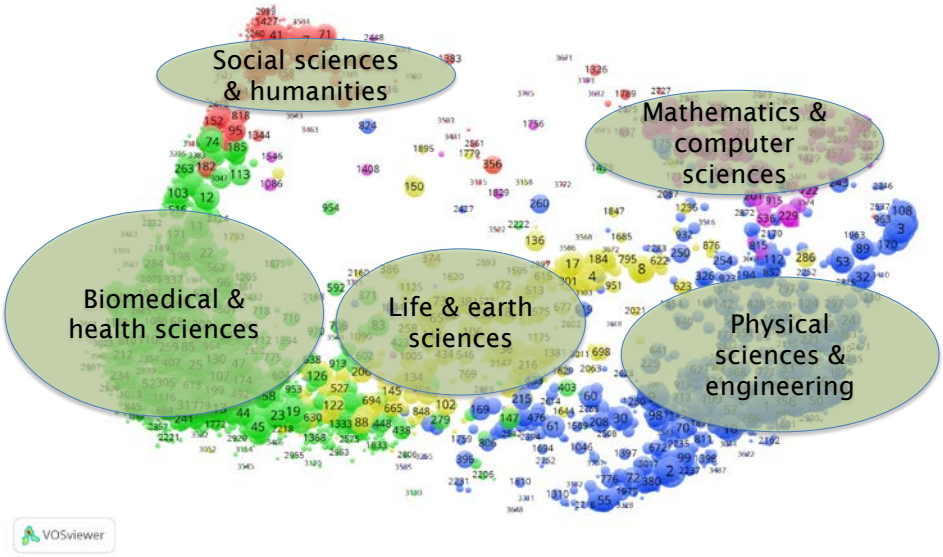
Multi-level clustering

The classification scheme at present has three different levels. The clusters are hierarchically organized. We discern the following levels.

1. A top level of around 25 clusters (fields)
2. A second level of around 800 clusters (sub-fields)
3. A third level of more than 4,000 clusters (research areas or micro-fields)

Labels

In a 'self-organized' classification scheme like this, the labeling of clusters is the biggest challenge. As such, our clusters have no name. Nevertheless, there is sufficient information available for each cluster to characterize them by the labels suggested. These suggestions are based on journal categories, journal names, keywords, publication titles and key authors. An impression of our classification scheme is depicted in the VOSviewer map below. In this map the citation relations between the clusters on the second level are used to position the hundreds of clusters in a two-dimensional space. The VOS mapping technique places clusters with strong citation traffic in each other's vicinity, while clusters with a weak relation are distant from each other.



Map of all sciences based on WoS publication classification (~800 clusters at intermediate level)

Annex C

Complete research profile (output and impact) of the University of Helsinki

Subject	P	P'	MNCS	MNJS
MULTIDISCIPL SC	1,193	386	1.57	1.56
ASTRON&ASTROPH	693	134	1.05	1.15
PHYSICS,PART&FIE	572	78	1.11	1.14
GENETICS&HEREDIT	551	132	1.57	1.57
ONCOLOGY	535	147	1.37	1.29
ENDOCRIN&METABOL	490	115	1.38	1.54
PUBL,ENV&OCC HLT	468	155	0.94	0.98
ENVIRONMENTAL SC	464	198	1.00	1.10
ECOLOGY	460	192	1.34	1.36
NEUROSCIENCES	448	175	1.13	1.28
METEOR&ATMOS SC	445	137	0.97	1.17
CLIN NEUROLOGY	430	148	1.43	1.29
BIOCHEM&MOL BIOL	420	166	1.45	1.33
PHARMACOL&PHARMA	366	164	1.23	1.24
PLANT SCIENCES	337	147	1.25	1.22
SURGERY	330	169	1.21	1.20
MEDICINE,GEN&INT	328	85	3.27	3.11
MICROBIOLOGY	320	141	1.19	1.22
PSYCHIATRY	287	78	1.17	1.11
CELL BIOLOGY	279	111	1.59	1.47
FORESTRY	270	126	1.05	1.00
PEDIATRICS	259	99	0.95	0.94
MATHEMATICS	246	149	1.42	1.33
CARD&CARDIOV SYS	246	68	1.90	1.62
PHYSICS,NUCLEAR	236	51	0.89	0.81
PHYSICS,MULTIDIS	235	41	2.97	2.82
IMMUNOLOGY	228	72	1.14	1.19

Subject	P	P'	MNCS	MNJS
EDUCAT&EDUC RES	227	162	0.84	0.87
PSYCHOL,MULTID	222	91	1.06	1.12
GEOSC,MULTIDISC	210	73	0.99	1.06
DENT,ORAL SURG&M	209	74	1.07	1.00
BIOTECH&APPL MIC	208	92	1.20	1.09
VETERINARY SC	207	108	1.06	1.03
GASTROEN&HEPATOL	200	86	1.38	1.27
PERIPHL VASC DIS	194	60	1.49	1.32
OBSTETRICS&GYNEC	193	69	1.13	1.05
NUTRITION&DIET	192	65	0.99	1.02
CHEM,PHYSICAL	190	90	1.33	1.26
FOOD SC&TECHNOL	189	103	1.08	1.24
CHEM,MULTIDISC	184	83	1.26	1.31
VIROLOGY	169	68	1.17	1.07
ZOOLOGY	165	91	0.74	0.73
EVOLUT BIOLOGY	158	65	1.54	1.57
HEMATOLOGY	156	35	1.34	1.33
BIOCHEM RES METH	154	70	1.07	1.25
UROLOGY&NEPHROL	151	47	1.27	1.30
INFEC DISEASE	149	42	1.01	1.02
MEDICINE,RES&EXP	141	43	1.47	1.44
PHYSICS,AT,MO&CH	121	58	1.06	0.96
GEOCHEM&GEOPHYS	117	47	1.17	1.20
MATER SC,MULTID	115	48	1.60	1.43
MARIN&FRESHW BIO	112	54	0.84	0.90
CHEM,ANALYTICAL	108	60	1.01	1.11
GERIATR&GERONTOL	107	27	0.60	0.76
RAD,NUCL MED IM	106	43	1.20	1.18
OTORHINOLARYNGOL	103	43	0.94	0.93

Subject	P	P'	MNCS	MNJS
MATH,APPLIED	101	54	0.88	1.00
RHEUMATOLOGY	101	23	0.97	0.87
PATHOLOGY	100	33	1.27	1.21
BIOLOGY	96	44	1.40	1.48
OPHTHALMOLOGY	95	53	0.81	1.02
PHYSICS,APPLIED	89	42	1.77	0.87
ANESTHESIOLOGY	88	32	1.10	1.22
PHYSICS,COND MAT	88	44	1.22	1.15
PHILOSOPHY	88	77	0.60	0.80
CHEM,ORGANIC	87	40	0.75	0.81
RESPIRATORY SYST	82	29	1.17	1.20
DERMATOLOGY	82	32	0.92	0.99
GEOGRAPHY,PHYSIC	81	30	1.11	1.12
BIODIV CONSERVAT	81	29	1.11	1.34
MYCOLOGY	80	35	0.79	0.90
ORTHOPEDICS	80	26	1.56	1.41
CRIT CARE MEDIC	80	19	1.61	1.64
LINGUISTICS	79	58	1.18	0.90
PHYSICS,MATHEMAT	74	39	1.24	1.35
PSYCHOL,SOCIAL	74	49	1.11	1.11
SUBSTANCE ABUSE	70	29	0.80	0.89
ENTOMOLOGY	70	38	0.54	0.63
ECONOMICS	69	45	0.82	0.74
LANGUAG&LINGUIS	69	56	0.92	0.75
BEHAVIORAL SC	69	31	1.18	1.23
EMERGENCY MED	69	25	1.11	1.00
REMOTE SENSING	67	27	1.32	1.30
CHEM,INORG&NUCL	67	33	0.96	0.83
POLYMER SCIENCE	66	37	1.06	1.07

Subject	P	P'	MNCS	MNJS
SOIL SCIENCE	64	28	1.19	1.03
PHYSIOLOGY	64	25	1.24	1.21
ENVIRON STUDIES	62	33	1.01	1.08
PSYCHOL,DEVELOP	60	23	1.06	1.03
AGRIC,DAIRY&ANIM	58	33	1.25	1.09
NURSING	57	19	0.68	0.95
SOCIOLOGY	57	41	0.93	0.86
TOXICOLOGY	57	26	0.84	0.83
MATH&COMPUT BIOL	57	28	0.68	0.74
HISTO&PHILOS SC	56	46	1.52	1.34
BIOPHYSICS	56	28	0.87	0.97
OPTICS	56	23	0.96	0.93
DEVELOPMENT BIOL	55	26	1.73	1.55
ALLERGY	54	15	1.07	1.16
OCEANOGRAPHY	54	17	0.79	0.99
NUCL SC&TECHNOL	53	23	0.80	0.74
INSTRUM&INSTRUME	52	17	0.77	0.73
RELIGION	52	47	0.80	0.63
TRANSPLANTATION	50	21	0.77	0.92
AGRONOMY	48	23	0.87	0.95
ENG,ENVIRONMENT	48	19	1.81	1.56
COMMUNICATION	48	35	0.96	0.92
COMP SC,AI	48	20	1.04	1.00
CHEM,MEDICINAL	47	19	0.82	1.01
PSYCHOL,EXPER	47	26	1.37	1.49
NANOSC&NANOTECHN	47	20	1.42	1.31
ORNITHOLOGY	46	15	1.16	0.93
STATISTICS&PROBA	45	24	0.85	0.81
PSYCHOL,CLINIC	45	17	0.90	0.86

Subject	P	P'	MNCS	MNJS
ENG,BIOMEDICAL	44	14	1.90	1.55
SOC SC,INTERDIS	43	32	0.59	0.70
ENG,ELEC&ELECTR	43	20	1.01	1.26
MEDICINE,LEGAL	43	22	1.15	1.00
HISTORY	42	38	0.41	0.92
SPORT SCIENCES	42	10	0.73	1.12
REPRODUCT BIOL	40	13	1.61	1.27
SPECTROSCOPY	40	15	0.93	0.91
HLTH CARE SC&SER	40	14	0.75	0.91
GEOGRAPHY	39	28	1.35	1.35
POLITICAL SC	38	25	1.15	1.03
COMP SC,INFO SYS	38	17	1.03	1.23
AGRIC,MULTIDISC	38	19	0.83	0.72
CHEM,APPLIED	37	19	0.94	1.00
PARASITOLOGY	36	15	1.81	1.60
ARCHAEOLOGY	36	24	0.73	0.90
MED LAB TECHNOL	36	14	1.19	1.14
COMP SC,SOFTW EN	34	15	0.72	0.96
MATER SC,BIOMAT	33	10	2.13	1.94
HUMANITIES,MULT	33	29	0.71	0.61
WATER RESOURCES	33	17	0.79	0.87
COMP SC,TH&METH	33	14	1.30	1.47
IMAG SC&PHOTO T	32	15	1.11	1.29
PALEONTOLOGY	32	10	0.94	0.67
PSYCHOL,EDUCAT	31	17	1.98	1.54
LAW	31	25	0.66	0.81
ENG,CHEMICAL	29	11	0.83	0.87
SOC SC,BIOMEDIC	29	15	0.72	0.78
INTERNATL RELAT	28	21	1.87	1.91

Subject	P	P'	MNCS	MNJS
ANTHROPOLOGY	28	16	0.53	0.97
GEOLOGY	27	12	0.81	0.82
MATER SC,PAPER&W	27	13	0.80	0.66
PHYSICS,FLUID&PL	26	8	0.78	1.16
PSYCHOL,APPL	26	12	1.01	1.13
HLTH POL&SERV	26	9	0.56	0.71
NEUROIMAGING	25	9	0.91	1.24
LIMNOLOGY	25	13	0.75	0.83
REHABILITATION	25	9	0.54	0.58
COMP SC,INT APPL	24	13	1.06	1.02
FISHERIES	24	12	0.73	0.83
BUSINESS	23	13	0.47	0.78
GERONTOLOGY	23	7	0.76	0.94
AUDIOL&SP PATHOL	23	9	0.66	0.70
DEMOGRAPHY	23	12	1.37	1.77
MANAGEMENT	23	14	0.68	1.05
LOGIC	22	15	0.81	0.85
EDUC,SCIENT DISC	21	11	0.64	0.87
ENERGY&FUELS	20	9	1.66	1.50
GREEN&SUST S&T	20	9	1.31	1.51
PLANNING&DEVEL	20	15	0.68	0.94
CRIMINOL&PENOL	20	14	0.19	0.84
TELECOMMUNICATIO	20	10	1.75	1.61
SOCIAL WORK	19	11	0.38	0.70
ETHICS	17	13	0.80	0.77
CELL&TISSUE ENG	17	6	0.96	0.97
MATER SC,COAT&FI	17	7	0.87	0.94
WOMENS STUDIES	15	13	1.39	1.33
MATH,INTERD APP	15	9	1.41	1.09

Subject	P	P'	MNCS	MNJS
CULTURE STUDIES	15	13	0.46	0.54
AREA STUDIES	14	12	1.10	0.80
EDUCAT,SPECIAL	14	9	0.24	0.30
URBAN STUDIES	13	8	0.87	1.37
LITERATURE	13	13	0.62	0.51
PRIM HLTH CARE	13	4	0.87	0.78
FAMILY STUDIES	13	8	0.79	0.76
ACOUSTICS	12	5	0.86	0.85
INFORM SC&LIBR	12	6	0.68	1.03
SOCIAL ISSUES	12	6	1.06	0.89
HORTICULTURE	11	7	0.37	0.49
MEDICAL INFORMAT	11	4	0.76	1.13
BUSINESS,FINAN	10	6	1.48	1.04
ART	10	9	0.22	0.75
ELECTROCHEMISTRY	10	5	1.15	1.22
ANATOMY&MORPHOL	10	5	0.41	0.47
MINERALOGY	10	3	1.11	1.06
PUBLIC ADMIN	10	7	0.92	0.86
MUSIC	10	7	0.97	0.92
MECHANICS	10	4	0.53	0.61
TRANSPORTATION	9	5	1.30	1.26
AGRIC ENGINEER	9	5	1.16	1.03
CRYSTALLOGRAPHY	9	4	0.24	0.66
ENG,MECHANIC	9	3	1.07	0.92
COMP SC,HARDW&AR	8	4	0.77	1.01
ENG,CIVIL	8	4	1.44	1.30
FOLKLORE	8	6	0.78	0.13
MATER SC,TEXTIL	8	4	0.96	0.89
ETHNIC STUDIES	8	5	0.82	0.88

Subject	P	P'	MNCS	MNJS
SOC SCI,MATH M	8	5	0.73	0.74
TROPICAL MEDICIN	8	3	1.17	1.08
THEATER	8	6	0.00	0.01
PSYCHOL,BIOLOG	8	5	1.10	1.02
METALLUR&MET ENG	7	3	1.00	1.55
ENG,MULTIDISC	7	3	0.08	0.45
COMP SC,CYBERN	7	3	0.13	0.18
AUTOM&CTRL SYST	6	3	2.39	1.66
OPERAT RES&MGMT	6	4	0.19	0.33
CONSTR&BUIL TECH	6	2	2.27	1.30
HISTORY SOC SC	5	4	1.34	1.47
ASIAN STUDIES	5	5	0.64	0.49
ERGONOMICS	5	2	0.98	0.93
HOP,LEIS,SPO&TO	5	3	0.73	0.92
MATER SC,CERAM	4	2	0.55	0.64
AGRIC ECON&POL	3	2	0.61	0.80
MEDV&RENAIS ST	3	3	0.76	0.59
INDUSTR REL&LAB	3	2	0.57	1.16
TRANSPORT SC&T	3	1	0.10	0.45
LITER THEO&CRIT	3	2	0.65	0.65
MINING&MINER PR	3	1	0.73	0.65
ANDROLOGY	3	1	0.73	0.81
LITER,GE DU SC	2	1	0.00	0.00
PSYCHOL,MATHEMA	2	1	0.19	0.15
INTEGR&COMPL MED	2	1	1.22	1.13
MICROSCOPY	2	1	0.34	0.31
MEDICAL ETHICS	2	1	0.66	0.74
THERMODYNAMICS	2	1	1.35	1.50
ENG,MANUFACTUR	2	1	0.26	0.35

Subject	P	P'	MNCS	MNJS
ENG,OCEAN	2	0	0.66	0.32
ENG,GEOLOGICAL	2	1	0.23	0.22
LITER,ROMANCE	2	1	0.00	0.06
ARCHITECTURE	1	1	0.00	0.47
MATER SC,COMPOS	1	1	0.00	0.48
LITER REVIEWS	1	1	0.00	0.17
CLASSICS	1	1	0.00	0.67
ENG,INDUSTRIAL	1	0	0.73	1.23
ENG,AEROSPACE	1	0	0.70	0.27
LITER,BRIT ISL	1	1	0.00	0.00

Annex D: UH performance in 35 main fields of science (aggregated WoS categories)

Main WoS field	P	P'	TCS	MCS	MNCS	PP (top10%)	MNJS	IC
CLINICAL MEDICINE	5,895	1,970	56,656	14.2	1.30	0.13	1.26	0.90
BASIC LIFE SCIENCES	2,107	786	27,908	19.3	1.37	0.15	1.32	0.94
PHYSICS AND MATERIALS SCIENCE	1,693	467	15,276	18.0	1.36	0.14	1.25	0.86
BIOMEDICAL SCIENCES	1,652	646	15,805	10.8	1.17	0.12	1.21	0.93
ENVIRONMENTAL SCIENCES AND TECHNOLOGY	1,515	670	10,573	8.2	1.14	0.13	1.19	0.77
BIOLOGICAL SCIENCES	1,222	566	8,057	7.9	1.05	0.10	1.06	0.80
MULTIDISCIPLINARY JOURNALS	1,193	386	16,658	22.4	1.57	0.16	1.56	0.90
EARTH SCIENCES AND TECHNOLOGY	1,078	373	7,432	7.9	1.03	0.11	1.12	0.82
CHEMISTRY AND CHEMICAL ENGINEERING	853	410	7,264	9.0	1.09	0.11	1.10	0.90
ASTRONOMY AND ASTROPHYSICS	693	134	6,302	30.4	1.05	0.09	1.15	0.90
AGRICULTURE AND FOOD SCIENCE	599	277	4,038	7.7	1.06	0.11	1.08	0.83
PSYCHOLOGY	484	223	2,534	5.9	1.09	0.12	1.13	0.77
HEALTH SCIENCES	408	135	1,542	4.7	0.66	0.03	0.84	0.73
MATHEMATICS	384	227	1,043	2.7	1.25	0.12	1.21	0.64
HISTORY, PHILOSOPHY AND RELIGION	301	252	353	1.3	0.81	0.08	0.90	0.29
EDUCATIONAL SCIENCES	292	199	696	2.4	0.90	0.10	0.91	0.44
COMPUTER SCIENCES	192	84	657	3.6	0.99	0.10	1.09	0.46
LANGUAGE AND LINGUISTICS	148	114	280	1.9	1.06	0.10	0.83	0.31
SOCIOLOGY AND ANTHROPOLOGY	140	99	319	2.6	0.85	0.06	0.89	0.39
BASIC MEDICAL SCIENCES	135	48	1,020	8.7	1.42	0.18	1.38	0.91
ECONOMICS AND BUSINESS	109	68	385	3.5	0.80	0.08	0.78	0.57
SOCIAL AND BEHAVIORAL SCIENCES, INTERDISCIPLINARY	107	64	337	3.8	0.81	0.06	0.93	0.54
LAW AND CRIMINOLOGY	94	61	258	3.3	0.73	0.07	0.89	0.47

Main WoS field	P	P'	TCS	MCS	MNCS	PP (top10%)	MNJS	IC
ELECTRICAL ENGINEERING AND TELECOMMUNICATION	82	39	385	4.5	1.33	0.17	1.36	0.54
POLITICAL SCIENCE AND PUBLIC ADMINISTRATION	76	53	224	3.4	1.40	0.14	1.36	0.30
ENERGY SCIENCE AND TECHNOLOGY	76	33	450	6.6	1.04	0.12	0.95	0.76
CREATIVE ARTS, CULTURE AND MUSIC	75	63	41	0.8	0.58	0.07	0.55	0.20
INFORMATION AND COMMUNICATION SCIENCES	60	42	171	2.7	0.92	0.09	0.94	0.32
STATISTICAL SCIENCES	58	32	149	2.8	0.76	0.06	0.74	0.67
MANAGEMENT AND PLANNING	57	40	160	3.0	0.81	0.04	0.94	0.42
INSTRUMENTS AND INSTRUMENTATION	54	18	157	5.0	0.74	0.05	0.71	0.72
MECHANICAL ENGINEERING AND AEROSPACE	33	13	164	5.1	0.85	0.08	0.84	0.76
LITERATURE	21	19	7	0.3	0.51	0.03	0.43	0.11
GENERAL AND INDUSTRIAL ENGINEERING	14	6	30	1.6	0.47	0.04	0.66	0.56
CIVIL ENGINEERING AND CONSTRUCTION	14	6	83	4.3	1.75	0.25	1.30	0.61

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